MASTERS THESIS M-3896

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THE MUSK OX UNDERWOOL, QIVIUT; HISTORICAL USES AND PRESENT UTILIZATION IN AN ESKIMO KNITTING INDUSTRY.

University of Alaska, M.A., 1972
Education, special

University Microfilms, A XEROX Company, Ann Arbor, Michigan

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A

THESIS

Presented to the Faculty of the

University of Alaska in Partial Fulfillment

of the Requirements

for the Degree of

MASTER OF ARTS IN ART-ADULT EDUCATION

By

Lillian Crowell Schell, B.S.

College, Alaska

May 1972

THE MUSK OX UNDERWOOL, QIVIUT;

HISTORICAL USES AND PRESENT UTILIZATION

IN AN ESKIMO KNITTING INDUSTRY

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ABSTRACT

THE MUSK OX UNDERWOOL, QIVIUT; HISTORICAL USES AND PRESENT UTILIZATION IN AN ESKIMO KNITTING INDUSTRY

Lillian C. Schell, M.A.
Musk Ox Project
University of Alaska, 1972

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The potential for establishing a cottage-type industry among arctic peoples, based on the underwool of domestic musk ox, was assessed from the results of a week-long knitting workshop conducted in Mekoryuk, Alaska (60°23'N, 166°12'W) during December 1968. Trial knitting lessons were devised and related to a cultural group speaking English as a second language. An exclusive village pattern was designed from a Punuk period, ivory harpoon head to be knitted in the musk ox underwool, trade-marked Qiviut. In ten months, there was an increase from 9 to 30 knitters.

Sufficient handcrafted scarves were produced from Qiviut, by Eskimo women at home, to show the validity of establishing a village knitting industry utilizing domestic musk ox fleece. These open-work scarves were found to be highly marketable.

In addition to the original program undertaken, a brief historical study of musk oxen and a résumé of Eskimo art stages are included.

ACKNOWLEDGEMENTS

I wish to thank John J. Teal, Jr. for the initial encouragement to undertake this study and the subsequent guidance during its progress. To Dr. Erna Gunther, Faculty Associate, Anthropology Dept., I wish to express sincere appreciation for her continued interest and assistance with the academic aspects of this thesis. Last, but not the least helpful of my committee, to Mr. Stan Zielinski who gave greatly of his time, I extend my appreciation.

I further wish to thank the personnel of the Musk Ox Farm, past and present, for their unfailing helpfulness and to extend special thanks to Helen Griffiths and Paul Wilkinson who have offered numerous constructive critisms. Invaluable assistance was supplied by the librarians of both the University of Alaska Library and the Naval Arctic Research Laboratory Library. None of this work would have been possible without the understanding and patience of my long suffering husband.

Finally recognition goes to the knitters of Mekoryuk, without whose co-operation and enthusiasm, this study would not have proved feasible.

This study was supported by the Musk Ox Project of the University of Alaska and the W. K. Kellogg Foundation.

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This thesis is dedicated to "the achievement of that greater wisdom, the happy adjustment of economy and environment."

Golden Fleece of the Arctic
J. J. Teal, Jr., 1958

Chapter I

INTRODUCTION

a. Sociological background

In an era when the earth's population is about to triple within the century, civilization is called upon to cope with poverty, lack of education and the demands of individual expression. The remote arctic is not immune from these pressures, and the needs of its people require consideration. No longer able or willing merely to survive on a traditional subsistence economy, arctic peoples desire increased opportunities for a more solidly based economy.

Under the pressures and compulsion of encroaching middle-class culture and technology from more populated areas, the peoples of the Far North have come to require as necessities food items and material goods that did not exist in their traditional past. Yet modern technology is slow to provide the means whereby they may obtain these new requirements such as coffee, soda, cigarettes, transistor radios, washing machines, snowmobiles, movies, ad infinitum. Cultures as well as individuals are irrevocably bound to their heritage; always it is the minority that must become acculturated. Today a social responsibility is recognized to reduce the cultural chaos inevitably resulting from transition.

The development of modern change among indigenous northern peoples has been chiefly through governmental programs. Originating outside the state, the programs seldom consider all aspects of the village situation. Also, as they have been imposed by an agency, often without consultation, they generally fail to elicit wholehearted co-operation. To close the ever widening chasm of economic and social differences existing in the North, it is imperative that programs proposing modification and change

directly involve the people participating in both the development and the fulfillment of these programs.

In an effort to ameliorate existing village conditions, the Institute of Northern Agricultural Research has investigated and domesticated the musk ox, Ovibos mochatus wardi, a ruminant uniquely adapted to the arctic and sub-arctic. The most immediate economic advantage from the domestic musk ox is its underwool, hereafter identified as 'Qiviut', from the Eskimo designation for an animal's undercoat. This trademark has been registered by I.N.A.R. to specify domestic musk ox down fiber. In meetings and correspondence with Native leaders and Village Councils, it has become apparent that they are avidly interested in raising this animal because it may provide the basis for a sound economy for their people.

b. Study outline

This thesis begins by outlining the historic utilization of the musk ox by the Eskimos and the explorers. It then gives a comprehensive coverage of the first textile research of the musk ox underwool undertaken in 1922 by Atkinson at Leeds University, England, as this source is not readily available. The next report on the textile potential of Qiviut by Werner Von Bergen in 1932 is also reviewed in depth.

An attempt to adjust the cultural impact of introducing the new craft media of knitting has been made by adapting an Eskimo motif to a knitting pattern. This pattern was used in the initial introduction of a knitting industry in the village of Mekoryuk on Nunivak Island in

Alaska. Following an analysis of the Qiviut workshop conducted by the writer in December 1968 at Mekoryuk, a summation of the results is given and the revisions of the knitting procedure employed are outlined.

c. Characteristics of the musk ox

Both the popular and scientific names of the musk ox, (Ovibos moschatus) are erroneous, since the animal has neither musk nor relationship to cattle (Teal, 1959). Comparative skeletal investigations performed by G. G. Simpson (1945), have clearly shown that they are far more closely related to goats and antelopes than to cattle. Confirmation of this conclusion has been established by Dr. Paul Moody (1958) through serological tests.

There are three subspecies of the musk ox recognized currently. Ovibos moschatus moschatus (Zimmerman) and Ovibos moschatus niphoecus (Eliot) both of which inhabit the Canadian mainland and Ovibos moschatus wardi (Lydekker) which is distributed over the Canadian archipelago and Greenland. Bee and Hall (1956) give the following physical description:

> Robust, buffalolike ruminant, 4 to 5 feet high at shoulder, with large head, hairy muzzle, short neck, short tail and short stocky legs; feet each with four hooves; skull massive and heavy; horns in both sexes unbranched, broad and thick at base where they nearly meet at midline of skull; horns curve downward along side of head then out and up; pelage black except for brownish black of upper parts; feet and nose white; occasional white hairs on face; underfur thick and wooly; 32 teeth (Bee and Hall, 1956, p. 253).

The shape of this animal, together with its shaggy outer hair and thick undercoat of fine wool, has enabled it to conserve heat well. It finds no arctic storm too severe. The Qiviut insulation has also reduced its food requirements, consisting of tundra grasses, sedges, willows, and

other browse.

The chief economic benefit to be derived from the musk ox is its marketable Qiviut. A musk ox will begin to shed its winter insulation anywhere from late April to early June, depending on its age and sex. The loose underwool is easily combed through the long guard hairs with the fingers. The Qiviut is generally collected from any one animal over a two-week period. The average yearling calf yields about two and a half pounds as compared with three and a half pounds plucked from an average three year old cow. Mature bulls may yield up to six pounds of Qiviut fleece (Wilkinson, personal communication).

Chapter II

HISTORICAL SURVEY

a. First literary description of musk ox wool and material uses of the musk ox by the Eskimos

Over two and a half centuries ago the first stockings were produced of musk ox wool that had been collected on the Canadian Barren Grounds by Jerémie, a French trader for a company in Hudson Bay. Made in France in 1708, they were reportedly finer than silk. In Jerémie's account, "Twenty Years of York Factory, 1694-1714", he states that the musk ox wool is longer than that of Barbary sheep and is very beautiful. From his description of the animal it is clear that this reference was to the outer guard hairs rather than to the underwool.

The following sighting took place between the Reindeer River and Seal River to the northwest of modern Churchill.

> These oxen, while smaller than ours, have yet much larger and longer horns. The bases of the horns meet at the top of the head where they form a large hump, and the horns hang down past the eyes almost as low as the mouth. The end of each horn then turns up, forming a kind of crescent.... The oxen have very short legs, so that their wool always drags along the ground when they walk, and this so confuses their appearance that even when only a short distance away, it is difficult to tell which end is the head (Jerémie, 1714, p. 19).

Anderson, translator of Jerémie's account, adds the footnote that this is the first published description of musk oxen. An earlier reference to musk oxen was made by Henry Kelsey in 1689, in which they are called 'buffalo'. Teal relates (personal communication) that musk ox were known to the 12th century Icelanders and Norsemen by the name of "sauur". The head and horns of this animal were hung in such cathedrals as Trondhjem and Oslo.

The next important published account of musk ox from personal observation was by Samuel Hearne during his third attempt to reach the

Coppermine River of northern Canada for the Hudson's Bay Company. In July 1771, he reported sighting numerous musk ox herds and described their pelage more fully than did Jerémie.

> ...their hair is in some parts very long, particularly on the belly, sides, and hindquarters; but the longest hair about them, particularly the bulls, is under the throat, extending from the chin to the lower part of the chest, between the forelegs; it there hangs down like a horse's mane inverted, and is full as long, which makes the animal have a most formidable appearance. It is of the hair from this part that the Esquimaux make their musketto wigs, and not from the tail, as is asserted by Mr. Ellis; their tails, and the hair which is on them, being too short for that purpose. In winter they are provided with a thick fine wool, or fur, that grows at the root of the long hair, and shields them from the intense cold to which they are exposed during that season; but as the summer advances, this fur loosens from the skin, and, by frequently rolling themselves on the ground, it works out to the end of the hair, and in time drops off, leaving little for their summer clothing except the long hair. The season is so short in those high latitudes, that the new fleece begins to appear, almost as soon as the old one drops off; so that by the time the cold becomes severe, they are again provided with a Winterdress (Hearne, 1795, p. 88-89).

The utilization of guard hairs for mosquito wigs is the first notation of a textile application, other than of hides, by people indigenous to the musk oxen's habitat. Eskimos used hides for moccasins as reported by Pike (1892, p. 166) and for trousers with the hair on by Birket-Smith (1945, p. 31). Hides were most commonly used as bedding, but J. W. Tyrrell reports purchasing a small 'topick', or lodge of beautiful musk ox robes (Tyrrell, 1897, p. 122).

Further searching of the historical material reveals assorted usages of musk ox horns and hides but no other textile applications by Eskimos. Various segments of the musk ox furnished the raw material for a wide variety of non-textile items such as a sledge (Ross, 1835, p. 174); skin scrapers and ladles reported by Captain Hall (Nourse, 1879, p. 91 & 412);

knife handles and a dozen other trade articles (Stefansson, 1914, p. 16); a marrow extractor (Birket-Smith, 1929, p. 147); and the lateral pieces on fish spears (Harper, 1964, p. 46).

A more inclusive study of the Eskimos' many daily needs supplied by assorted parts of the musk ox is supplied by Kaj Birket-Smith. Many articles in the material cultures of the Netsilik and Copper Eskimos are represented in the Danish National Museum's ethnographical collections from the Northwest passage. Among the items cataloged are numerous horn soup-ladles (pp. 29, 124, 196, 259) which were occasionally used to play a form of roulette by spinning them (Birket-Smith, 1945, p. 121). Horns were also utilized as adze heads (pp. 29, 105, 206), mouthpieces for bow drills (pp. 29, 107), tangs and handles for the women's ulu (pp. 29, 104, 203, 204), bag buttons (pp. 145, 165), hunting bows (p. 162), a pendant with the front edge drilled to form a double cross ornamentation and worn to give health (p. 133), harpoon head stem (p. 172), a button on a breathing hole searcher (pp. 173, 250), breathing hole scoops to remove slush and ice chips (pp. 174, 252), a toggle on a seal dragline (p. 176), several blubber pounders made from the distal end of a musk ox horn with four half-rounded notches for the fingers in the concave side (pp. 90, 194, 257), also drinking cups were made from the distal end (p. 198), and skin scrapers that doubled as cutting boards (Birket-Smith, 1945, p. 210, 212).

The teeth of the animal served as amulets (pp. 130, 132), a scapula as a scraper (p. 210), a rib as a drill bow (p. 109), the skin for thongs (p. 209), the underwool for a chin tuft on a mask (p. 127) while a urine bladder, a stomach and a 24 cm length of a musk ox rectum tied

at the bottom were utilized as bags (Birket-Smith, 1945, p. 100). The foregoing clearly indicated that when there were no game restrictions on musk ox and it was plentiful all over the Arctic, it was hunted as a traditional phase in the life of the Eskimo. Theirs was a non-textile application of the animal fibers available to them.

b. Exploitation of musk ox by explorers and sportsmen

References to musk oxen during the nineteenth century by the host of explorers searching either for the Northwest Passage, the lost Franklin Expedition or for new land in the Arctic, invariably dwell on slaughtering herds to provide meat for survival (Franklin, 1823, pp. 331-332); (Back, 1836, p. 401); (Simpson, 1843, p. 234); (Davis, 1876, pp. 353-363); (Hall, 1879, pp. 411-415); (Greely, 1886, pp. 81-84, etc.); (Peary, 1898, p. 338); (Sverdrup, 1904, V. I, pp. 43-47, V. II, p. 147); (Cook, 1911, pp. 33-37); (Peary, 1910, pp. 151-161); (MacMillan, 1918, p. 60-69); (Anderson, 1919, pp. 506-507); (Storkerson, 1922, p. 14); (Stefansson, 1921, pp. 581-582).

Not only were numerous herds slain for the support of various Arctic expeditions conducted within their habitat, but also the musk ox was taken in appreciable numbers by sportsmen (Pike, 1892, p. 166); (Whitney, 1896, pp. 216-235); (Seton, 1912, p. 233); (Hanbury, 1904, p. 165); (Whitney, 1910, pp. 290-311) and naturalists (Russell, 1898, p. 144).

These beleaguered animals were on the verge of extinction, not only from the depredation of explorers and trophy hunters, but also, due to the fashion for musk ox robes during the later half of the nineteenth century.

Hewitt describes musk ox robes as requiring two or three skins and varying in price from $50 to $350 in accordance with its size and quality (Hewitt, 1921, p. 98). In the fifty-five years before the Canadian Government legislated complete protection for the musk ox, Hudson's Bay Company records reveal that over 15,000 skins passed through its five trading districts (Tener, 1958, p. 399).

c. Early interest in the domestication of the musk ox and the textile potential of its underwool

It is more within the European tradition to utilize animal fibers for textile purposes as exemplified by the stockings Jerémie had made from musk ox underwool. These stockings were known by Pennant, who based his second description in the natural history literature on a skin procured for him from Hearne by Samuel Wegg of Hudson's Bay Company's London office. He recorded his impression of the musk ox underwool in these words:

> Beneath every part of the hair grows in great plenty, and often in flocks, an ash-colored wool, most exquisitely fine, superiour, I think to any I have seen, and which might be very useful in manufactures if sufficient could be procured (Pennant, 1792, p. 10).

Early during the next century a similar observation was made by explorer-naturalist Richardson:

> The wool of the musk ox...would no doubt be highly useful in the arts if it could be procured in sufficient quantity (Richardson, 1829, p. 277).

The availability of musk ox wool concerned a third writer and was expressed in a manner similar to Richardson's but with a practical suggestion added. Baird, in 1854, is reported by Hewitt (1921, p. 311) as

having published the first statement concerning domestication as a means to efficient collection of its fleece. Hewitt ascribes the following quote to S. F. Baird from an article written for "Pictorial Geography of the World" by E. S. Goodrich, Vol. II, pp. 39-40:

> The hair is very long and silky, and has been occasionally worked into articles of dress. Could it be obtained in sufficient quantity, there is no doubt of its being of exceedingly great value in the arts...the experiment of domestication as well as of economical application in general, must be tried, if at all, by the Hudson's Bay Company (Hewitt, 1921, p. 311).

By personal communication Teal has reported that among others who have recommended the domestication of musk ox have been Parker Gilmore, 1874; C. J. "Buffalo" Jones, 1898; A. G. Nathorst, 1900; and L. H. Bailey, 1905.

Although the softness and warmth of the musk ox undercoat has been noted in the literature and noted as having been sighted scattered across the arctic tundra (Peary, 1898, p. 323); few report collecting it. The only explorers who report collecting wild musk ox wool for textile application are Nathorst and McClintock. Nathorst (1901) as cited in Major (1964, p. 46) brought musk ox wool from east Greenland. He had it spun and woven into usable cloth. Reportedly he found the fiber to be unusually firm and elastic in spite of its fineness, and according to experts Nathorst consulted, it was comparable to vicuna wool. McClintock reports (MacFarlane, 1905) that the warmest gloves have been made out of the soft, silky underfur of the musk ox.

From personal communication (Teal, 1971) it was also learned that many Norwegian sealers speak of the days prior to World War I when they collected musk ox wool in Greenland for their wives to spin and knit into scarves, mittens and gloves.

After returning from five years in the Arctic, Vilhjalmur Stefansson generated much international interest regarding the domestication of the endangered musk ox. While wintering on the north coast of Melville Island, Stefansson sent a small sample of musk ox wool to Sir Robert L. Borden of the Naval Service in Ottawa. In his letter, dated March 15, 1917, he concluded with the following paragraph:

> I most sincerely believe that musk oxen can make a square mile of the arctic tundra as valuable as sheep can a square mile of Alberta. The reindeer cannot hope to do the like, nor can the yak compete in wool or in its power to thrive near the pole (Appendix A).

For the next forty years Stefansson continued to elaborate and publish his domestication dream for these animals. An entire chapter in his book, The Northward Course of Empire is devoted to this proposal. He reported the following efforts to secure textile information on the underwool:

> From ovibos skins which were brought south by our expedition (Canadian Arctic Expedition 1913-18) and from others belonging to Captain Henry Toke Munn, who has a trading station in northern Baffin Island, we were able to get together fifty or sixty pounds of wool. Some was worked by hand into socks and mittens in the ordinary 'old-fashioned' way, but this yielded little definite information from the commercial point of view. Secretaries Lane and Redfield, then members of President Wilson's Cabinet, became interested and a small sample was submitted through them to the United States Bureau of Standards, but their report was inconclusive. Certain Canadian manufacturers of woolen cloths undertook to have the wool tested and received considerable quantities of it, but apparently were not really interested or else did not have the proper facilities, for so far as I know, this has not as yet come to anything. The wool secured from Captain Munn (about 40 pounds) was handed over to Professor Alfred F. Barker, head of the Textiles Department of Leeds University. Through a period of months he had conducted experiments of all sorts (Stefansson, 1922, pp. 165-166).

The experiments referred to above, on the wool from Captain Munn's musk ox hides, were carried out by Leeds University, England under the direction of Professor Barker and provided the data for Frank H. D. Atkinson's master's thesis in 1922. This 52 page, handwritten thesis

titled, "The Study of the Ovibos (Musk Ox) and the Possibilities of Ovibos Fibre from a Textile Standpoint" begins with a brief summation of information current to that year on the animal and the origin of the research.

Unfortunately the musk ox wool supplied to Leeds University had been combed from hides rather than gathered from live animals during the natural shedding process. The combed underwool contained sufficient guard hairs to hamper the fiber's performance in the spinning and subsequent weaving operation. Aside from the drawbacks caused by the presence of the long coarse outer hair, Atkinson describes the underwool as "really extraordinarily soft" and to be "compared with the finest cashmere or vicuna" (Atkinson, 1922, p. 9).

The technical half of the Leeds thesis first states the properties and morphology of sheep's wool, then compares ovibos fibers with fibers from eight other animals. From microphotographs Atkinson determined that ovibos down fibers possessed straight edges and few scales with projecting edges and noted the indistinct medulla, the cellular marrow which contains the fiber's pigmentation.

Comparative microphotographs of merino and Lincoln sheep fibers show the first to have distinct scales with projecting serrations, while the second type had fewer scales apparent but a more conspicuous medulla.

Notations in reference to the remaining fibers revealed the following information. Camel hair had straight edges but a distinct medullary portion unlike the ovibos fiber. Cashmere, the fiber most like musk ox wool, showed few visible scales, had straight edges and indistinct medulla; however, the cortical layer was distinctly striated. Epidermal scales of the mohair fiber were apparent but with few projecting serrations and no

visible medulla except under polarized light. Vicuna, also very similar to the musk ox fiber, was straight edged and showed few distinct scales. These two characteristics also applied to brown alpaca; however, the medulla was conspicuous as well. For final comparison, Atkinson chose angora rabbit fur which showed a ladder-structured medulla with no projecting serrations (Atkinson, 1922, pp. 19a-19e).

On the basis of these comparative microphotographs, Atkinson deduced the following list of musk ox undercoat characteristics:

1. The fiber is more nearly a hair than a wool fiber.
2. Consequently does not possess any marked scales or serrations with a free or projecting edge.
3. Lack of waves.
4. Comparative straightness of fiber.
5. Apparent lack of gelatinous substance in the interstices of the scale structure (Atkinson, 1922, p. 25).

These factors also explain the non-milling property of ovibos fibers according to Atkinson. The lustrousness of musk ox wool was also remarked upon favorably.

It was previously stated in the Leeds thesis that the musk ox undercoat shared with cashmere:

> that outstanding delicious softness, which is so well known.... The very handle, although comparing favourably in softness with cashmere and vicuna, appears however to be the outcome of a fiber more akin to a very fine hair rather than a wool (Atkinson, 1922, p. 19).

Atkinson follows his fiber discussion with an account of processing the ovibos fiber and the machinery used. Scouring of the plucked fleece was not deemed necessary as it contained so little natural grease and no vegetable matter.

A preliminary carding trial was unsuccessful due to the great variation in fiber length between the coarse outer hair of 2.4 cm to 30.4 cm

(8"-12") and the undercoat of 7.6 cm to 8.8 cm (3"-3 1/2"). Even with diligence it was not possible for the Leed's experimenters to extricate all the long hairs from the fine musk ox underwool. The presence of these guard hairs was a continuous source of frustration and inhibited the performance of the musk ox wool during each stage of processing.

Following the carding of musk ox fleece on the Scribbler section only of a Cheviot Woolen Card, the sliver of 2.65 grams per yard was sent through the Offerman Prince Smith Gill Bot with a small draft before combing on the Noble Comb which was set for a 36's-40's quality wool. After going through the finishing gill botes, the ovibos fiber passed through an open drawing set to form two weights of roving for spinning.

The weight of sliver behind the first operation of drawing equaled 26.57 grams per 40 yards. Multiple doublings resulted in roving of 7.7 grams per 40 yards and 15.4 grams per 40 yards. From these two weights of roving were spun both weaving and hosiery yarn.

The weaving yarn of 1/20's was spun with 10 t.p.i (turns per inch) then plied in thirds as 2 ply with 5 t.p.i.

2 ply with 7 t.p.i. and 3 ply with 5 t.p.i. The hosiery yarn of 1/10's was spun with 7 t.p.i.; then half was plied as 2 ply with 5 t.p.i., and the remaining was 3 ply with 2.5 t.p.i.

Atkinson further reports that tests for strength and elongation were conducted on the spun yarn before actual weaving or knitting took place. The musk ox yarn spun by Leeds University possessed average strength. Prior to being machine woven, samples were tried on a handloom to learn how the yarn would behave in weaving. No further information was given on this aspect.

A Hutchinson and Hollingworth, American wheel dobby power loom with a worm wheel let-off motion was used to weave the musk ox yarn. The warp of 2/20's English worsted yarn was set for 30 ends per inch in a 15-dent reed. The filling was also 30 picks per inch for a 2 up/2 down twill. Hopsacking and an 8-shaft honeycomb were woven as well as the twill.

Atkinson describes the weaving performance of musk ox yarn on the power loom as follows:

> The 2/2 Twill wove fairly well but even here there were a goodly number of ends down, caused by the slipping of the fibers at the weak places brought about by the long hairs. The long hairs also frequently caught in the weft stop fork thereby causing the loom to stop automatically when not required. It might be mentioned also that the hairs caused troubles in the Mails by getting caught up and consequently bringing the end down (Atkinson, 1922, p. 43).

Following the weaving of the three types of cloth, they were scoured in a Dolly Scouring Machine with the addition of soda ash to water. The next operation attempted on the ovibos fabric was that of milling. Atkinson reported that samples processed in 5% acid, even milled in stocks, did not shrink in width or length. Better fabric cover was achieved with 10% acid, but 20% acid with the milling taking place for two hours gave the best opacity. He does not give further information as to the composition of the acid solution used.

The milling operation previously described resulted in a bursting of the yarn to such an extent that the fiber ends had come to the outside of the cloth, and some had actually worked out of the yarn completely. This gave the fabric an exceptionally soft handle; however, the long hairs still present caused a prickling sensation when gliding the hand across the surface. Furthermore, decided weight differentials were evident between the milled and unmilled samples. Atkinson's chart of the weights per

yard is reproduced in Table 1.

Table 1. Weights of Musk Ox cloth per yard

Not submitted to milling	Submitted to milling
2/2 Twill (56" x 36")	
2" x 2" = 9.8 gns.	2" x 2" = 8 gns.
Wt. per yard = 11.2 ozs.	Wt. per yard = 9.2 ozs.
Plain Weave	
2" x 2" = 10.2 gns.	2" x 2" = 9.9 gns.
Wt. per yard = 11.7 ozs.	Wt. per yard = 11.3 ozs.
Honeycomb Weave	
2" x 2" = 10.5 gns.	2" x 2" = 9.8 gns.
Wt. per yard = 12 ozs.	Wt. per yard = 11.2 ozs.

*Atkinson, 1922, p. 45

Although the extremely soft ovibos fabric was unfairly compared with worsted wool on the McWalter Law's Rubbing Machine to ascertain wearing properties, the worsted fabric lasted only ten minutes longer. Atkinson, however, did not attach much importance to this test as there were so many other variables not taken into account.

As was mentioned earlier, some of the musk ox fleece was spun for hosiery experiments. This yarn was sent to Wolsey Underwear Ltd. for knitting into socks. They reported that the 3/10's and 3/16's worked up better on their machinery than did the 3/20's. After trial wearings of these socks by Atkinson and his major professor, Mr. A. F. B. Barker, they concurred as to the socks' great warmth but disliked the guard hairs which tended to prickle and tickle their feet.

Atkinson concluded his thesis after quoting a letter from the head

of Derwent Mills Ltd., Derbyshire, who expressed his opinion of the musk ox fiber as follows:

> I think if this material could be procured in fair weights there would be a market for it in knitted goods. It seems to be more suitable for knitting than for weaving (Atkinson, 1922, p. 49).

This opinion of its marketability concurs with that of Atkinson in his conclusion, whereupon he adds, "without any admixture of the long coarse outer hair". Not only did he consider the natural brown coloration advantageous as it would ameliorate the dyestuff situation of the 1920's, but also the non-milling property of the musk ox fiber was cited as advantageous. His reasoning was that the air retaining qualities of a fabric are practically coincidental with its heat retaining properties.

Further information regarding the Leeds' musk ox fabric was found in Stefansson's papers after his death. A suit-length woven during Atkinson's experiments was presented to the King of England in 1923 and an appropriate release prepared for the press:

> The first specimen woven in the Department was brought to the notice of the King at the time of the meeting of the Imperial Conference in October, and, having expressed his interest in the experiment, His Majesty has graciously accepted the piece (Appendix 1b).

In the same year that Atkinson's thesis was written, the Report of the Royal Commission upon the Possibilities of the Reindeer and Musk Ox Industries in the Arctic and Sub-Arctic Regions of Canada reached the following conclusion:

> There is apparently no question as to his (musk ox) adaptability to domestication and your commissioners are convinced that if the matter is gone about in an intelligent and businesslike way, any expenditure which may be incurred in his preservation and further development will be amply repaid (Anonymous, 1922, p. 17).

This report is illustrated with photographs of a musk ox wool sock supplied by V. Stefansson, a pair of over socks knitted by Madame Bernier in 1909, and one of spun yarn incorrectly labeled 'carded' musk ox wool. In the appended testimony of the Royal Commission's report, Hornaday, curator of the New York Zoological Society, expressed the opinion that he did not believe musk ox wool could ever become a valuable commercial product (Anonymous, 1922, p. 54). On the other hand, Captain Munn who had captured and transferred the six calves to New York wrote: "musk ox wool has a market value; it is a slippery wool rather like Shetland" (Anonymous, 1922, p. 59).

Shortly after the Royal Commission's Musk Ox and Reindeer Report was published, the Thelon Game Sanctuary was set aside as one of the measures undertaken by the Canadian government for the protection of the few remaining musk ox on the North American continent. It would seem that the Royal Commission's findings were unknown to C. H. D. Clarke when he wrote his report on musk ox observations in the Thelon Game Sanctuary sixteen years later. In this report he remarks that the wool is unfortunately smooth and not true wool, and cannot be used by itself (Clarke, 1940, p. 84).

d. 1930 transplant of Greenland musk ox to Alaska and textile research into its underwool

Musk oxen continued to be newsworthy throughout the next decade, but although Stefansson's suggestion of domestication was always lauded, no action was taken. The Territory of Alaska was particularly interested in the musk ox, as the animal had historically roamed the Territory's Arctic

Slope (Allen, 1913, pp. 187-189) (Bee and Hall, 1956, pp. 253-255). In 1930 a Congressional appropriation enabled Alaska to obtain seed stock (Ovibos mochatus wardi) from Greenland. The primary aim of the transplant was eventual restocking of the animal's former range; however, the possibility of domestication was a secondary consideration, according to Young (1943), and Palmer and Rouse (1963).

Thirty-four musk oxen, half calves and the remainder yearlings and two-year-olds, were captured and crated in Greenland, then shipped via Norway to New York. Still crated, they spent a month in quarantine in New Jersey. When released from quarantine, the animals spent seventeen days in transcontinental shipment. The musk oxen travelled by express car to Seattle, steamer to Seward and again by rail to Fairbanks, Alaska, where they were finally uncrated on November 4th at the Biological Survey Experiment Station (Young, 1943, p. 320).

All animals, nineteen females and fifteen males, were in good condition when released into a forty-acre enclosure at the Experiment Station (Palmer and Rouse, 1963, pp. 2, 8). Figure 1 is a photograph taken of the musk ox herd about the time they first arrived at College, a town located outside of Fairbanks.

Knowledge of the maturity age of musk oxen, their diseases and parasites, food requirements, and daily habits, were all part of the life-history study initiated by L. J. Palmer, senior biologist for the Biological Survey Station, under the U.S. Department of Agriculture. Great interest was evinced in these rare, shaggy animals at the nearby fledgling Alaska College throughout the six years that they were observed and cared for by the Biological Survey Bureau.

Figure 1. Musk ox calves after release at the Biological Survey Station, College, Alaska, in 1930.

At the conclusion of his section of the report on 'Musk Oxen Investigations in Alaska 1930-35', Palmer makes the following statement:

> For domestic use the musk ox offers possibilities for development both as a farm and a range animal. Because of its slow moving habit, ease of feeding and ready response to handling, the musk ox should prove especially adaptable to the farm. As a farm animal, the wool could be most conveniently collected (Palmer and Rouse, 1963, p. 35).

The first spring after the herd became ensconced at the Biological Survey Station, their underwool was collected and sent to Werner Von Bergen, chief chemist for the Fortsmann Woolen Co., to be analysed. In the fall of 1931 he published his findings as a series of articles in the Melliand Textile Monthly.

Von Bergen begins his study of the physical properties of musk ox wool with the following description of the undercoat:

> Next to the skin is a growth of fine light grey wool (down) so dense as to be impervious to moisture. The wool hair is very soft and has a silky gloss. It is whitish grey towards the skin and changes to a grey. The point of change is very sharp. The length of the white zone varies from one sixteenth of an inch to over one inch, depending on the place where the hair grew.... No regular staples are formed since the down grows nearly evenly over the whole skin. On some places, especially on the back part, the wool hairs have the tendency to grow into beard hair (Von Bergen, 1932, p. 3).

Since the musk ox is unrelated to any better known species of wool-bearing animal, Von Bergen goes on to say that a decision can only be made as to which specialty hair fiber it comes nearest by studying the microscopic structure of its fiber. Under microscopical examination Von Bergen reports musk ox wool scales to be clearly visible and the average number of scales per 100 microns to be six. He also noted, as had Atkinson, that medullae were seldom found. He then went on to state that musk ox fiber widths were extremely regular and fine.

Table 2. Fineness comparisons of musk ox wool, cashmere & merino

	Musk Ox Wool		Cashmere	Australian Merino
	Shoulder	Back		
Root end....	11.55μ*	11.25μ	14.25μ	15.33μ
Middle part...	13.65μ	15.77μ	16.63μ	18.22μ

*1μ or micron equals 0.001 millimeter or 1/25400 of an inch

(Von Bergen, 1932, p. 5)

After remarking on the regularity and fineness of musk ox fiber widths, he made the following observation:

> ...it can be seen (Table 2) that the musk ox wool hair from the back and shoulder parts comes closest to the cashmere wool hair in its microscopic structure and as far as fineness points are concerned, it is even superior. In a blend of these two fibers it will be nearly impossible even with the microscope to separate the fibers for an accurate analysis (Von Bergen, 1932, p. 9).

Whereas Leeds University had great difficulty in removing guard hairs from the soft underwool by the English worsted system, this problem could be overcome by the use of cashmere machinery. Von Bergen pointed out that regular commercial cashmere wool contains about 30% beard hairs. During the carding and spinning they are separated to the extent that the finished goods contain less than one-half percent of the beard hairs. A one pound sample of musk ox wool from the Alaska Experiment Station animals yielded 84% usable fiber with a fat content of 4.3%, about the same as for raw cashmere.

The fiber properties of musk ox, vicuna, cashmere, and camel hair (technically all are hairs) were compared in the 1932 report, and Table 3 is reproduced from it on the following page. Due to its high fineness

Table 3. °+ Fiber properties of musk ox, vicuna, cashmere & camel hair

WOOLHAIR	MUSK OX (White-Faced) Alaska		VICUNA	CASHMERE	CAMEL (Fine)
Color.....	Gray White-gray		Brown	White-gray Brown	Red brown
Luster.....	Good		Good	Good	Good
Handle.....	Extra soft Silky		Extra soft Silky	Extra soft Silky	Soft Silky
Lengths.....	1 1/2"-6"		1/2"-2 1/2"**	1 1/4"-3 1/2"	1"-5"
Bulk	3-5		2	2	2 1/2
Waviness....	Curly		Curly	Curly	Curly
Scales per 100 microns.....	6		7-9	6-7	9
	Visible		Poorly visible	Clearly visible	Poorly visible
FINENESS					
	Root	Middle			
Under 15μ...	91%	51%	79%	52%	39%
15-25μ.....	9%	47%	21%	48%	52%
Over 25μ....	0%	2%	0%	0%	9%
Average	11.4μ	15.3μ	13.4μ	15.0μ	17.5μ
QUALITY					
English.....	140	100	120	100	80
Medullated Fibers....	None		Numerous	None	Numerous
BEARDHAIR					
Color.....	Brown and Black		Brown	White Br. & Blk.	Brown
Length, Inches	1"-16"		8"	1 1/2"-5"	2"-5"
Fineness Average...	100μ		75μ	60μ	60μ

**° + (Von Bergen, 1932, p. 8). Von Bergen, 1963, V. I, p. 421.

as shown previously in Table 2, the musk ox fiber is more sensitive to chemicals, alkalies and acids than sheep's wool. Qiviut's response to the chemicals used in textile processing is not a serious limitation as cashmere and mohair are also very sensitive to them. For each of these fibers bleaching impairs the fiber's soft handle and reduces its tensile strength (Von Bergen, 1963, pp. 341 & 360).

After publishing the first section of his article on the textile potential of musk ox wool, Von Bergen obtained the original copy of Atkinson's thesis from Stefansson which enabled him to make comparisons in data. The fleece each had experimented with came from different sub-species of musk ox. Atkinson's wool had been obtained from Ovibos moschatus moschatus (Zimmerman) of the continental Canadian Arctic and Von Bergen's wool had been supplied from Ovibos moschatus wardi (Lydekker), the so-called white-faced musk ox of Greenland and the Canadian archipelago (Harington, 1961, p. 85).

As Von Bergen observed, the main difference between the Canadian and Greenlandic species is the color of the underwool.

The Ovibos moschatus mochatus underwool is brown whereas the fleece of Ovibos moschatus wardi, that being the musk ox transplanted to Alaska from Greenland, is gray. Otherwise, the physical properties of the underwool are essentially the same as Von Bergen showed in Table 4, below, which has been reproduced from his report in the Melliand Textile Monthly.

Table 4. Comparison of White-Faced and Canadian musk ox wool

WOOLHAIR	MUSK OX White-Faced New York 1930		MUSK OX Canada Leeds
Color.....	Gray White-gray		Brown
Length			
Bulk.....	2-5		3-3.5
Scales per 100 microns.....	6 visible		6 poorly visible*
FINENESS	Alaska middle	New York	
Under			
15 microns..	51%	38%	48%
15-25μ	47%	59%	48%
Over			
25 microns..	2%	3%	4%
Average	15.3μ	16.53μ	16.15μ
BEARDHAIR			
Color	Brown & Black		Black
Length.....	1"-16"		8"-12"

*Covered by dyestuff pigments (Von Bergen, 1932, p. 12).

Von Bergen's report revealed additional information concerning the Leeds musk ox fabric presented to the King of England (Appendix 1b). Two pieces, enough for three suits, had been woven from yarn plied of musk ox yarn and yarn of Yorkshire's most typical wool, the Wensleydale. Von Bergen expressed the opinion that this combination with the coarse English wool was an unfortunate one, since the character and soft handle of the musk ox wool had been entirely covered by the coarse Wensleydale wool. These unsuccessful woven samples may well have curtailed interest in raising musk ox for their fiber as a commercial venture.

After completing his extensive textile research, Von Bergen enthusiastically stated:

> ...it is my belief that the musk ox wool hair, growing on the shoulders of the animal is the finest wool hair which is known today. I am convinced that the musk-ox wool will become a valuable commercial product after domestication (Von Bergen, 1932, pp. 9 & 11).

In addition to the textile study completed by Von Bergen, the carding and hand-weaving qualities of musk ox wool were taken under consideration by the College Extension Service. From 1930 until 1943 several news articles on the musk oxen established at the Biological Station appeared in "The Farthest-North Collegian", the student newspaper for the Alaska Agricultural College and School of Mines. The successful results of the musk ox wool carding and weaving experiments may best be ascertained through excerpts from these news articles.

The first published notice of local exploitation of the musk ox wool in "The Farthest-North Collegian" July 1933, was under the headline, 'Extension Service Experiments Various Wools'. The second and final paragraph reported that:

> The musk ox wool gathered this spring is undergoing experimentation and being woven into scarfs by the Extension Service (p. 3).

Later that same year, in December, the "Collegian" ran a story on 'Exclusive Musk Ox Scarfs a Distinct College Feature'. The bulk of the news story is quoted below.

> Unique scarfs, hand-woven by co-eds, from musk ox wool is gaining recognition as a distinct feature of only the Alaska Agricultural College and School of Mines, reports Miss Lola Cremeans, Director of the Home Economics Department here.
>
> Wool was gathered by hand from the musk ox range early last summer, under the direction of Lawrence J. Palmer, Senior Biologist .... The wool was turned over to Mrs. Lydia Fohn-Hansen, Extension Service worker, to "use as she saw fit". And Mrs. Fohn-Hansen deserves much credit for her ingenuity in working this light gray

> wool into fine yarn by the process of carding, spinning and weaving, by hand, into attractive scarfs.
>
> Deciding to make a College project, the wool was transferred to the Home Economics Department, where girls, wishing to pay part of their expenses at College, are now working it up into charming scarfs, which are being sold for ten dollars each.... The desirable scarfs of blue and gray, cleverly pattern woven with a design of a musk ox, are used as gifts (The Farthest-North Collegian, December 1933, p. 8).

As shown by the foregoing news item, the handspun yarn proved ideal for weaving when it was used for the filling (weft) threads as well as for bulky knitted items. Before the wool could be spun, however, it had to be carded. The carding process was tedious due to the difficulty of removing sticks and leaves from the range-gathered musk ox wool. This fact, no doubt, influenced the attempt to have the musk ox wool commercially spun as reported by the "Collegian" in February 1935.

> To test its possibilities for commercial spinning, a small amount (of musk ox fiber) was sent to the Pendleton Woolen Mills to be machine spun. While the amount was too small to be spun to advantage, its spinning properties were proven to be excellent. The machine-spun yarn compared favorably with the hand-spun product (p. 6).

Mrs. Fohn-Hansen's sister knitted some of the Pendleton machine-spun musk ox wool into a vest (Figure 2a) for her brother who wore it for many, many years without its showing any signs of wear. She kindly let me photograph it and a scarf like those described in the "Collegian" (Figure 2a). The scarf was handwoven during the early 1930's on a blue woolen warp. Both ends have a broad, blue sheep's-wool band with a centered figure of a musk ox woven of musk ox wool in a raised pile technique at one end only. A similar scarf was sent to Werner Von Bergen at his home in New Jersey by Mrs. Fohn-Hansen in March 1935. In his reply he remarked:

Figure 2(a). Musk ox wool, handknitted vest and handwoven scarf produced during the 1930's. Photo by Joseph G. Holty.

Figure 2(b). Machine knitted Qiviut^{R} sweater produced by The Hadley Corporation in 1958. Photo by Jimmy Bedford.

> The scarf you sent me was a real surprise and a happy one. It added to my collection of fibers and their products one of the most rare and interesting species. Everyone in the mill from the management down admired the wonderful touch given to the scarf thru the musk ox hair.
>
> The first use I made of the scarf, was to use it as a cover on my newborn son. Words really cannot convey my sincere appreciation of this gift (Appendix 1c).

Once the musk ox had reached maturity, the musk oxen proved difficult to contain even in an enclosure of over five hundred acres. This and the depredation of calves by black bears were among the reasons for removing them from the College area. During the summer of 1935 four adult animals, two bulls and two cows, were transferred from the Experiment Station to Nunivak Island in the Bering Sea. The following summer the remaining animals were crated and barged via the Yukon River route to predator-free Nunivak Island (Palmer and Rouse, 1963).

Even after the musk ox were removed from the vicinity of the Alaska Agricultural College and School of Mines, they continued to make headlines in "The Farthest-North Collegian". In the December 1943 issue the feature story was on 'Alaska's Musk Ox Wool'. When reviewing the Home Economics students' use of the musk ox wool, the article reported as follows:

> The difficulty was to get the yarn spun. Some was sent to Pendleton Woolen Mills and spun without charge except for postage. But the quantity was too small for mills to be interested; furthermore, the handspun yarn had a superior "feel" which was a selling point in a hand-woven product.

From the foregoing comment it would seem that the 1943 news article gave a more honest appraisal of the Pendleton machine-spun musk ox fiber than did the writer of the February 1935 news item.

To weave a large number of scarves required considerable yarn. The

few hand spinners at College were unable to keep the student weavers supplied, nor could a stock of machine-spun musk ox yarn be counted on to fill the demand. The 1943 account of the musk ox yarn production continued:

> Mrs. Russel of Seward offered to do the spinning....and was in a position to spin all the yarn needed. She reported that the yarn (fleece) was easy to handle and had scarcely any waste. Every skein she returned was perfectly blended and the yarn uniformly fine. She was paid 50¢ an ounce for the spinning.

Mrs. Fohn-Hansen (personal communication) conveyed the information that Mrs. Russel used a converted treadle sewing machine to spin the musk ox wool. This method of spinning assured an ample yarn supply for weaving purposes. The "Collegian" went on concerning the financial aspect of the musk ox wool production:

> Scarfs sold for from $4.00 to $10 each, and students were paid $2.50 for the weaving.... Bookkeeping accounts showed that a total of $708.24 was realized from the sale of articles, and $705.31 had been spent on the project, incidental expenses (The Farthest-North Collegian, December 1943, p. 7).

Although the musk ox wool items produced and sold in the 1930's showed so little profit, the efforts were well received and proved the existence of a market for hand-produced accessories of the musk ox fiber.

Mention should be made of the interest aroused by the Alaskan musk ox experiment in Greenland and Denmark as shown by excerpts from Hone's (1934) report to the American Committee for the International Wildlife Protection, re. Musk Ox Situation in Northeast Greenland:

> There is an additional reason to the mere preservation of an interesting animal from extermination for the Danish Government taking such action (a musk ox reserve). The Danish Government justifies its position in maintaining Greenland as a virtual government monoply on the ground that it holds it in trust for the native Greenlanders .... One of their great problems today is to convert the Green-

> landers from being mere hunters to another economic life (Hone, 1934, pp. 27-28).

After quoting from Palmer's report on the Bureau of Biological Survey Experiment Station's work with musk ox, Hone stated:

> Through proper cultivation of semi-domesticated musk ox herds the Eskimo might be able to raise most of their own food in their own environment and obtain a salable and exportable product in the wool gathered from the herds. This would go far toward solving the Danish Government's Eskimo problem. The initial stages of experiment and development should be, and necessarily must be, carried on by the government. It will be easier to turn the Eskimo into musk ox herders...than into miners (Hone, 1934, p. 28).

Hone's recommendation for the Danish government to back domestication of the musk ox proved as effective as the Royal Commission's recommendation; although willing to acknowledge the advantages of domestication, no government was willing to invest in such a long-term venture.

e. Domestication by I.N.A.R. and Qiviut experiments

The first scientific approach to domesticating the musk ox began in 1954 by the Institute of Northern Agricultural Research. Believing in the intrinsic value of its underwool, and determined to develop mankind's first domesticated animal in recent history, John J. Teal, Jr., as Director of I.N.A.R., obtained permission from the Canadian government to capture several musk ox. During the summers of 1954 and 1955 the Institute successfully captured six calves in the Thelon Game Sanctuary without killing or injuring any adults. Up until then the practice had been to shoot all the protective adults to obtain calves for transplant experiments or zoos.

The calves were flown to the I.N.A.R. facilities at Tunturi, Hunt-

ington Center, Vermont where they quickly adapted to a farm routine. These musk ox were objects of management and disease studies as well as scientific experiments. While under intensive observation in Vermont, the animals' wool undercoat was collected for commercial evaluation. It is the Qiviut (registered trademark) obtained from the musk ox wherein lies their chief economic value and the rationale for their domestication.

In May or June the animals shed their wool undercoats which insulates them against the coldest arctic temperatures and the severest polar storm. The soft, gray-brown fleece is easily lifted off the back and sides of the musk ox by the handful. When sufficient Qiviut had been harvested, it was processed by the Forté Cashmere Company of Boston.

The finest of all natural fibers, Qiviut has proved to be readily dehaired on special processing machinery designed by Forté. Any diameter of guard hair can be removed to produce the grade of wool desired (Teal, 1958, p. 8). In 1958 the Forté Cashmere Company spun a 2-ply, 6 1/4-run yarn and bleached a small portion of the natural, taupe yarn.

Once spun, this yarn was then turned into sweater samples by the Hadley Corporation (Figure 2b). Through correspondence with them it was learned that the sweaters were...

> made on an 18 gauge, full fashion knitting machine. This machine is....the standard machine used for men's knitted outerwear. The ribbing on the machine was made on a separate flat bed dubied rib knitter, 8 gauge. The sweater(s) (were) processed as we normally process a Cashmere sweater, was given the same type of wet finishing and the usual stitching construction (Appendix 1d).

Two of the sweaters manufactured by The Hadley Corporation are still in the possession of I.N.A.R. while another is on file with The Hadley Corporation. These sweaters have proven the commercial potential of

Qiviut.

Once I.N.A.R. had achieved its initial objectives with the musk ox transplanted to Vermont, it then proceeded to establish a larger breeding herd in Alaska. In 1964 a grant from the Kellogg Foundation and private funding enabled I.N.A.R. to capture musk oxen from the herd on Nunivak Island.

Twenty-eight years after the Biological Survey herd of musk ox had been transferred to Nunivak Island, twenty-three of their progeny returned to the same area. These calves, fourteen females and nine males, plus ten females caught in 1965, are currently settled on an old homestead purchased by the University of Alaska. By 1971 this herd had increased to 94.

In 1965 the Qiviut from these animals was utilized in a textile study by Mrs. Dorothy Reade, a craftswoman from Eugene, Oregon, noted for her unusually fine handspun yarn from every variety of fiber. In her research on the qualities and characteristics of handspun Qiviut, Mrs. Reade spun and knitted with pure Qiviut and also combined it with merino wool, silk waste and Dacron^{R}.

The handspun Dacron^{R} was plied with single ply Qiviut and knitted into socks of excellent durability and warmth. Socks knitted of Qiviut and merino plied together were softer. The merino also imparted its greater shape-retention properties to the Qiviut without sacrificing any of its angora-like softness. In addition to the yarn made for the socks mentioned above, Mrs. Reade handspun yarns of various weights and plies of Qiviut and combined it with the other fibers previously mentioned. She then went on to work the handspun yarn into test squares and small lace scarves.

Her view of Qiviut after these experiments is given below:

> The undercoat of the musk ox (Qiviut) is a very remarkable, beautiful and manageable fiber that presents no problems to an experienced handspinner. It is soft, strong, lightweight and does not shed. It seems to possess the softness of angora with the toughness of wool, but without the drawbacks of either. Although Qiviut does not have quite the length of staple in some fibers (wool, mohair, etc.) it is far above other exotic fibers such as cashmere, angora, vicuna, etc. The guard hairs are easily removed by hand, and as there is only a nominal amount of oil, it can be spun very readily as is (i.e. without rinsing or carding....) I have done research on almost every known fiber, and not one of them combines so many excellent features (Reade, 1965, pp. 1-8).

Designating Qiviut as a luxury fiber, best utilized in knitted items, Mrs. Reade concluded her report with suggestions for its use. The wool would be suitable for all types of ski accessories, for sweaters from bulky weight to very lacy and stoles as well as for inner socks and gloves for arctic wear. Furthermore, she wrote, knitting yarns of Qiviut would be absolutely superlative. She also expressed the opinion that Qiviut might well be applicable to space apparel due to its light weight and thermal properties.

This section of the historic utilization of the musk ox and its wooly undercoat, brings us up to the present application of the domestic Qiviut to an Eskimo knitting industry. A brief discussion follows which outlines the stages of Alaskan Eskimo art. An ivory harpoon head from the Punuk stage inspired the knitting pattern designed for the first Eskimo Qiviut workshop.

Chapter III

PREHISTORIC STAGES OF ESKIMO ART AND DEVELOPMENT OF A KNITTING TECHNOLOGY

a. Art styles trace cultural stages

The presence of a highly developed art among races that are in a primitive stage of cultural development has always been of particular interest to ethnologists and art historians alike. Boas (1927) has stated that the appreciation of esthetic value of technical perfection is not confined to civilized man, for in the households of all primitive people patience and careful execution characterize most of their products. He also expressed the realization that the Eskimos have both physioplastic and ideoplastic art.

Hoffman (1897), Nelson (1899), Jenness (1922) and others noted that the Eskimo of the Arctic, not unlike the paleolithic cave-dwellers of western Europe or the primitive Bushmen of South Africa, possess a remarkable artistic ability. The skill with which the Eskimos carved and engraved on bone and ivory excited the admiration of every early explorer. Jenness (1922) makes the statement that:

> ....graphic art was universal among the Eskimos, extending from Alaska on the one side to Greenland on the other; it dates from prehistoric times until the present day. Every large museum in Europe and America is filled with excellent examples of it. There are not only carvings of men and animals, free and in relief, but exquisite engravings, from elaborate representations of hunting and domestic scenes down to simple geometrical patterns (Jenness, 1922, p. 161).

The harpoon that the Eskimo uses to capture the sea mammals on which his livelihood depends is a tool greatly aiding the archeologist in his task of determining regional chronologies and tracing cultural change. The harpoon is a composite implement made up of a wooden shaft with an ice pick at the butt end, a finger rest at the center and at the fore

end a socket piece, loose foreshaft, and detachable toggle head. The component parts of the harpoon vary from region to region, changing through time. So it is particularly true that the toggle harpoon head, more than any other Eskimo artifact, possesses the characteristics essential for a 'time indicator' (Collins, p. 96, 1964).

In addition to harpoon heads, and art, developmental changes may be traced in other classes of artifacts such as winged objects, needle cases, bird darts, bone and ivory arrowheads, fish line sinkers, knives, adzes and ivory runners for the small hand-drawn sled. Many other culture items besides those named above, box handles, knife handles, and scrapers, also were decoratively inscribed, beginning with the graceful and elaborate designs of Old Bering Sea and ending with the stiffly conventional geometric style of the present time.

It is generally recognized on the basis of considerable archeology done throughout the Canadian, Alaskan and Siberian Arctic that different cultural phases of development can be determined by changes in forms of harpoon heads and styles of decoration. By classifying the decorative elements inscribed on harpoon heads and associated artifacts, it is possible to outline the art stages which evolved in the prehistoric Eskimo culture. To simplify the discussion, only the prehistoric art of the Alaskan Eskimos is herein taken under consideration.

Six styles of decoration have been recognized as representing six stages of an Alaskan Arctic Whale Hunting culture. The total complex of culture traits is essentially the same in each stage, however, the types of harpoon heads and associated implements differ. After discussing the interpretations of other archeologists, Rainey makes the following state-

ment regarding the various cultural phases:

> ....just as the Old Bering Sea stage can be distinguished from the Okvik stage by a new style of decoration, new forms of harpoon heads, and by modified forms of the same general classes of implements, so a Punuk stage can be recognized upon the same basis (Rainey, p. 560, 1941).

Further on he compares the eastern and western phases of the Thule culture stage then makes the observation that:

> The total culture patterns as defined for the Thule stage in the eastern Arctic and the Late-Prehistoric and Modern stages in the west correspond very closely; they have in common types of sled shoes, dog harness equipment, bird figures used in a game, and some items of hunting gear such as seal scratchers. But, above all, the implements from these three stages are coarsely made, crude, rarely decorated and then only with simple patterns; while the Okvik, Punuk, and Old Bering Sea stages are characterized by carefully and beautifully fashioned implements and elaborate engraved decoration (Rainey, p. 562, 1941).

It is these elaborate or geometric designs which are regularly applied as surface decoration to harpoon heads that are the one aspect of Eskimo art under specific consideration in this thesis.

b. Okvik stage

The oldest recognized stage of an Alaskan Eskimo culture is termed Okvik. Rainey (1941) so designated this earliest of art styles after the site where it was first discovered on Punuk Island in the Bering Sea. Okvik, according to the Saint Lawrence Island Eskimos, means "place where many walrus haul up", a particularly suitable designation, since more walrus ivory artifacts have been excavated from this prehistoric site than any other, indicating that great walrus herds came ashore there many centuries ago as they do today.

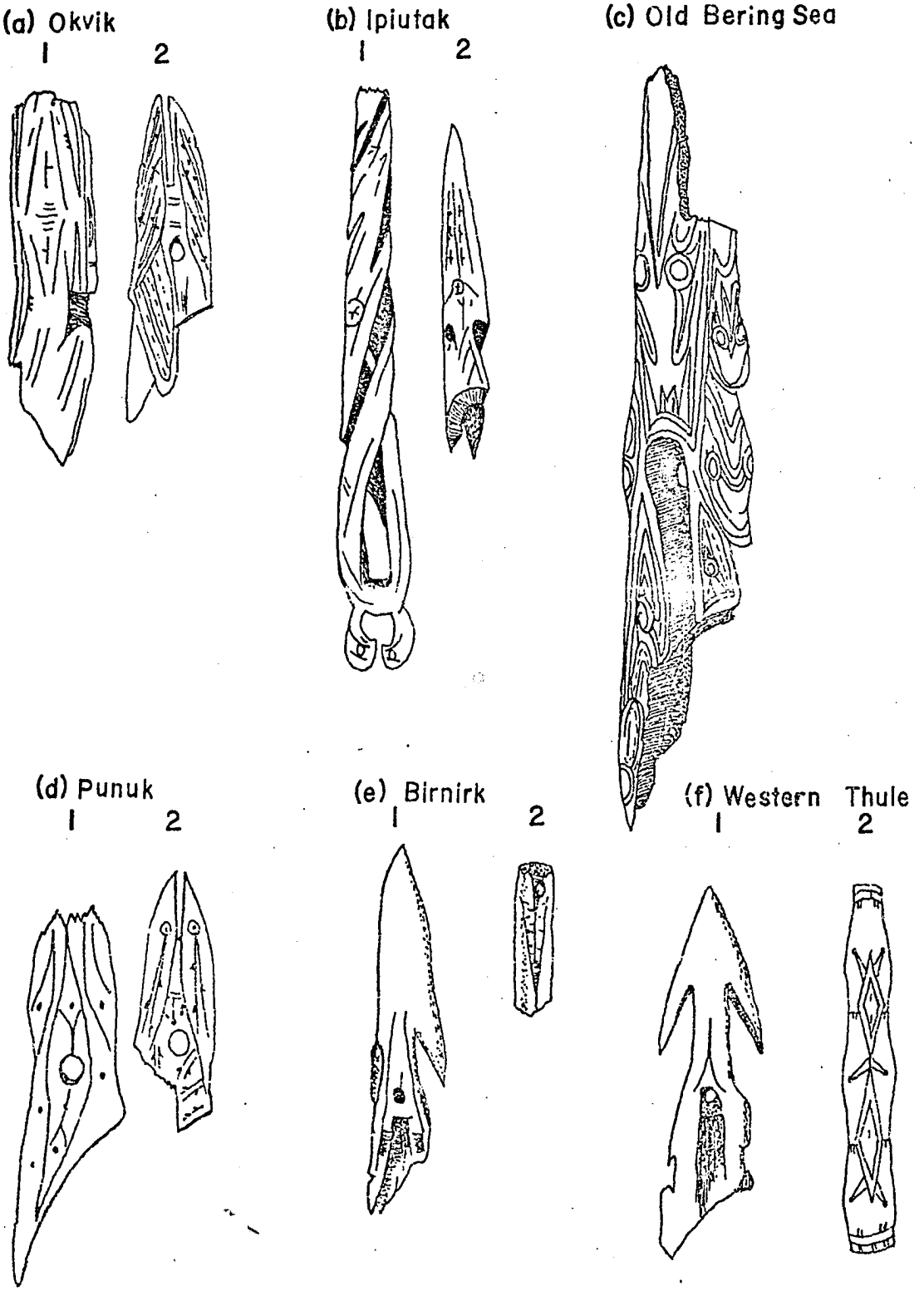
The Okvik artist's outstanding contribution is in the field of free form carving. The most noted example of this achievement is the so-called Okvik Madonna, an ivory figurine representing a mother holding a babe in arms. The elongated head and prominant nasal bridge are characteristic elements of Okvik figure carving, but the curious twisted smile is unique to this one specimen.

The overall effect of the Okvik style is distinctive in the manner of finish and combination of the individual motifs; whereas, the geometric elements engraved on harpoon heads and other implements are essentially the same as those of the later Old Bering Sea and Punuk stages. As illustrated in Figure 3a 1 and 2, Okvik ornamentation is comparatively simple; the elements are combined into effective patterns almost entirely restricted to straight or slightly curving lines. Other motifs are the spurred line, the double line, the broken line and the nucleated and concentric circle.

The eight artifacts which Collins unearthed from under the bottom house stones at his Hillside site on Punuk Island and which he designates "Old Bering Sea Style I" actually belong to the earlier, Okvik culture phase as proven by later archeological evidence. In describing these few harpoon heads, Collins remarks that:

> ....the full possibilities of these elements had not been realized; they had not been selected out and made to serve as the basis of elaborate and complex designs such as characterized a later stage of Old Bering Sea art. On the contrary, this simpler style was distinctly linear; and circles, when present, were of incidental importance as compared with a profuse decoration consisting of long radiating lines, shorter detached lines, and single or double lines to which were attached very long, sharp spurs (Collins, p. 46, 1937).

Figure 3. Styles of Alaskan Eskimo harpoon head from each culture phase



The engraved designs of the Okvik culture phase, as Rainey (1941) points out, are much simpler, more sketchy, more irregular and less pleasing than the complex curvilinear designs of the Old Bering Sea phase that followed it on Saint Lawrence Island. Closely related to the Okvik art style is the Ipiutak, according to Larsen and Rainey (1948) since specimens with typical Okvik decoration have been found in Ipiutak houses. Furthermore, excavated burials indicate that Okvik and Ipiutak were contemporaneous, even if Ipiutak dated back further than the former (Larsen and Rainey, 1948).

c. Ipiutak stage

Ipiutak is the name given an ancient form of Eskimo culture first found in 1939 at Point Hope, Alaska, by James L. Giddings, Jr., Froelich G. Rainey and Helge Larsen. The Ipiutak village site is located about one mile from the present Eskimo village, Tigara, on the Arctic coast.

The most common realistic motifs in Ipiutak surface decoration are schematic faces and the so-called skeleton motif, stylized ribs and spines engraved on animal carvings. The skeleton motif may have had religious significance when applied to some items, however, when the skeleton is more or less conventionalized, it appears to be purely ornamental.

This transition from realistic to geometric design is typical of Ipiutak decorative art. The purely geometric design is reminiscent of the Old Bering Sea art, especially in its earliest known form, the Okvik style. The elements of which it is composed are about the same in the two art forms; only the Ipiutak design is usually simpler and is applied

to a wider range of artifacts.

It is in carving in the round, however, that the Ipiutak artist is especially distinguished. The site at Tigara contains not only numerous carvings in ivory and antler but also a great number of weapons and tools decorated with carvings. Animals, and in particular animal heads, were the favorite motifs of the Ipiutak carvers. This animal complex, according to Larsen and Rainey (1948), is suggestive of the Scytho-Siberian animal style. The presence in the Ipiutak site of such characteristic elements as the pear-shaped boss on the hips of animals, the griffin head, and the skeleton motif supports strongly the supposition that the Ipiutak animal style originated in Asia.

The so-called openwork carvings, peculiarly shaped ivory objects which were mainly found in the surface burials, have been interpreted as shaman's regalia. They are non-utilitarian and probably of some symbolic significance. The swivel shown in Figure 3b 1 from the Ipiutak burials clearly illustrates the mastery of ivory carving that the Eskimo carvers had in this culture. The two twisted prongs of the swivel are slit so that the two sections of the body consist of four spiral bands. Larsen describes the bifurcated flange at the shaft bearing as suggestive of a caribou foot motif (Larsen and Rainey, plate 58, 1948).

Characteristic features of Ipiutak surface decoration include: lines with various degrees of curvature; straight lines, most commonly four equally spaced, longitudinal lines; branching straight lines; as well as effective combinations of light and heavy lines. The 'Y'shaped figure and spurred lines form other common elements. The spurs are usually short, straight, unilateral and equally spaced, but long, oblique and

bilateral spurs also occur. Broken and dotted lines are less common although rows of triangular dots are not infrequent. Specimens showing hachured areas in the design are scarce.

The foregoing design elements are often combined in the Ipiutak style in relatively simple compositions with circles to form a pattern fitting the surface to which it is applied. Circles occur in various forms as ellipses, pointed ovals and kidney-shaped figures, either plain or spurred. The interior of these closed, rounded motifs are decorated either with a dot, a cross, two or three short lines or an asterisk but most commonly with a dot and circle (Larsen and Rainey, pp. 135-144, 1948). An example of this frequently used motif is illustrated in Figure 3b 2 which is an Ipiutak harpoon head decorated with a dot and circle motif with radiating lines below the line hole, with traces of red paint in the lines (Larsen and Rainey, plate 5, #3, 1948).

After further discussion and citing illustrative specimens, Larsen and Rainey state that the position of Ipiutak decorative art in relation to Eskimo art as a whole is clear.

> It is closely related to the characteristic curvilinear style of the Okvik and Old Bering Sea phases. Since Ipiutak art in general is simpler and less conventionalized, we assume that it represents an earlier stage of the art of these two culture phases (Larsen and Rainey, p. 144, 1948).

d. Old Bering Sea stage

The Old Bering Sea style of Eskimo art has been described by all the well known Arctic archeologists. However, Collins, in his definitive work, "Prehistoric Art of the Alaskan Eskimo", outlined its characteristic

features most clearly. The design elements listed by him are:

> (1) nucleated circles and ellipses, usually concentric and often surmounting low rounded elevations; (2) the arrangement of these on certain objects so as to suggest the eyes of an animal; (3) deeply excavated centers to some of the circles, sometimes inset with discs of baleen or other material; (4) small circles at the inner angle of two converging lines; (5) spurs attached to the circles and lines; (6) straight and curved lines; (7) finely incised broken or dotted lines; (8) an occasional checked or hachured area; (9) raised borders to grooves and rounded lip-like projections (Collins, p. 11, 1929).

In the text following the above list of motifs, Collins notes that, in considering the shapes and the surface elevations or depressions of the objects, it can be seen that they also form an important part of the decorative scheme. The ivory harpoon head shown in Figure 3c illustrates this principle well, as the entire surface is covered with a typically elaborate pattern. The incised lines of the design are in bands and converge to form triangular, diamond-shaped, and elliptical motifs. Several bosses, outlined by concentric circles, appear in pairs, suggestive of animal eyes and form a row of heads along the lateral sides of the harpoon head. The wide, flat side is also intricately patterned with these shapes, leaving no part of the specimen undecorated (Geist and Rainey, p. 187, 1936).

As Collins states it, "the Old Bering Sea art is marked by a profuse but extremely graceful application of lines, curves, and circles in such a way as to realize to the utmost, within the limits of the accepted patterns, the artistic possibilities of the surfaces to be covered" (Collins, p. 11, 1929). The total effect achieved by the Old Bering Sea artist is a free-flowing, curvilinear style both complex and sophisticated. The classic Old Bering Sea style, observes Rainey (1941), marks the high point in an ancient Eskimo art which deteriorated in later times.

e. Punuk stage

It is generally recognized that the Old Bering Sea culture phase was the predecessor to the Punuk. This later culture phase derived its name from archeological sites excavated on the Punuk Islands group, southeast of St. Lawrence Island, by Collins from 1928 to 1930 and by Geist from 1927 to 1935. The following description of decorative elements from Punuk artifacts continues the classification of Eskimo art styles.

Punuk art is rich in examples of geometric surface decoration. It is readily identified by the simplified use of straight or slightly curving lines, as contrasting with the delicate and variable incised lines of the more elaborate Old Bering Sea art style. Spurred lines and the 'Y' figure are common design elements. The pronged or 'Y' motif is usually attached to a base line and boldly executed.

Perhaps the most distinctive feature of the Punuk style is the use of perfectly round, compass-engraved circles with centered pits, either placed freely about the design or at the ends of short lines. There is a sharp contrast between the precise circles of the Punuk period and the graceful, slightly irregular, often elliptical motif of the more complex Old Bering Sea style (Figure 3c). Figure 3d 1 and 2 with their simple, linear decorations characterize the Punuk phase of Eskimo art in the Bering Sea area. The ornamentation of the second Punuk harpoon head combines both the spurred line and the typical circle and dot motif (Collins, plate 11a, plate 15b, 1929).

The designs resulting from the combined Punuk motifs, according to Collins, appear rigid and mechanical when compared to the elaborate

flowing designs of the earlier art. After further discussing variations among the forms of Punuk harpoon heads, he remarks on the differing visual impact between the Old Bering Sea and Punuk styles due to technique:

> The old curvilinear designs were deftly applied; some of the lines were lightly etched while others, for contrast, were deeper. The impression received is that the artist exercised selective judgment as well as manual skill in the harmonious arrangement of the lines, curves and panels that make up the composition. The Punuk art, on the other hand, shows no such discrimination. The lines are all uniform and usually quite deep. There is still a slight tendency to utilize the outline of the object for the enhancement of the design but not to nearly such an extent as in the older art. Designs are much more formal and rigid; on harpoon heads, for example, the relatively simple ornamentation is repeated almost exactly over and over again. The same adherence to convention is seen in many of the other objects, resulting in a fixed mechanical style, which though symmetrical and graceful in its simplicity, distinctly lacks the elasticity and exuberance that mark the finer products of the Older Bering Sea culture as works of real art (Collins, pp. 27-28, 1929).

Noticeably slender harpoon heads, each made from bone, and closely associated with Punuk harpoon heads, are found in the archeological sites on Saint Lawrence Island. The form and material of this type of head are diagnostic of harpoon heads from the Birnirk culture period. These Birnirk specimens are reported as found in the general horizon of Punuk types, definitely above Old Bering Sea harpoons but below Thule (Geist and Rainey, p. 228, 1936). Geist delineates the ornamentation of the Birnirk types as consisting of simple engraved lines running the length of the heads on either side of the cutting blades.

f. Birnirk stage

Examples of the type of harpoon head known as Birnirk, were first identified from the prehistoric Eskimo village of that name explored by Stefansson on Point Barrow. The Birnirk site is a complex of 16 dwelling

mounds about six miles from Barrow. The ancient Eskimos of this culture period were just beginning to hunt whales in addition to seals and walrus. They also hunted land-mammals and birds and knew the use of dog sleds, umiaks and kayaks.

Clark Wissler (1916) published a descriptive account of the harpoon heads collected by Stefansson in 1908. Harpoon heads and darts were also acquired from other, more recent sites along the Arctic coast besides Birnirk. While the Birnirk harpoon heads show little or no ornamentation, those from Cape Smythe, the site closest to Birnirk in age and location, do show a variety of simple, linear decoration.

By the same token, both Mathiassen (1930) and Mason (1930) report few decorated harpoon heads in the artifact collections made from the Point Barrow vicinity by Knud Rasmussen and Van Valin respectively. These three collections included not only prehistoric, but also historic culture items.

From 1931 to 1932 and again in 1936, James A. Ford systematically investigated Birnirk and other ancient sites on the Arctic coast. Most of the harpoon heads of the Birnirk culture phase collected by Ford are described by him as follows:

> ....simply decorated with straight, incised lines that diverge from the median ridge about halfway between the line hole and the blade point and pass on each side of the line hole to intersect the lashing slots. Also, a short incised line is often found extending above the line hole (Ford, p. 77, 1959).

Figure 3e 1 illustrates an harpoon head of this style (Ford, p. 76, Fig. 26b, 1959). Only occasionally, states Ford, the well known 'Y' motif was employed as decoration on the harpoon heads. Although the ornamentation becomes virtually nonexistent on the harpoon head of the Birnirk and western Thule phases, other associated culture items continue to be

decorated with the spurred line, 'Y' shaped figures and the traditional circle and dot motifs. An ivory toggle dug up at Birnirk, shown in Figure 3e 2, is an example of the vestigial ornamentation of this culture phase (Ford, p. 217, Fig. 105, o, 1959).

Although Murdock, in writing of art as produced by the Point Barrow Eskimos, was primarily describing historic specimens, his statements could well be applied to the prehistoric art of that area:

> whenever the bone or ivory parts of weapons are decorated the ornamentation is usually in the form of incised lines colored with red ocher or soot. These lines rarely represent any natural objects, but generally form rather elegant conventional patterns, most commonly double or single borders, often joined by oblique cross lines or fringed with short, pointed parallel lines. A common ornament is the incised 'circle and dot' (Murdock, p. 390, 1892).

There is firm archeological evidence to support the theory that the Birnirk culture period gave rise to that of the Thule phase which later spread across Canada to Greenland and back to Alaska.

g. Western Thule stage

The first prehistoric Eskimo culture to be identified and systematically described in the literature is termed Thule, from the locality in northwestern Greenland where it was first found by Therkel Mathiassen. However, it is the Western, rather than the Eastern culture stage which he first reported in 1921, that is of interest in this paper.

More sculptured animals and figurines than decorated harpoon heads are associated with this culture stage in the archeological sites of Alaska. Collins regards the Thule art style to be very close to that of the modern Alaskan Eskimo. He goes on to say that:

> Comparatively few examples of decorative art are included in the Thule finds, and what there is shows but little resemblance to the ancient Alaskan art.... Lines, spurs, the 'Y' figure, and the dot are the geometric elements represented; the circle was not found. Most significant however is the presence in the Thule culture of a few crude examples of realistic etchings of animals and objects. This type of art has never been found at an ancient site in Alaska, although it is a most characteristic feature of modern Alaskan Eskimo art (Collins, p. 43, 1929).

When decoration is present on the Thule harpoon heads, he further states, it is restricted to the plain 'Y' motif about the line hole, with an occasional enlargement of the 'Y' element into a triangular hachured area. Figure 3f 1 is a typical Thule, style two, harpoon head (Bandi, Fig. 60-2, p. 151, 1969). The decorated ivory needle case in Figure 3f 2 from Cape Krusenstern clearly indicates that the western Thule Eskimo had not totally give up ornamenting his implements, but merely shifted his artistic efforts to items other than harpoon heads.

The harpoon head decorative styles changed among the prehistoric Alaskan Eskimos, reaching a peak during the Old Bering Sea stage and declining or rigidifying upto historic times. Clearly, art played a rather important role in the Okvik and Old Bering Sea phases. In the Okvik style close parallels are apparent to Ipiutak art. The Punuk, Birnirk and western Thule phases used progressively fewer and more simplified design elements. An attempt has been made to present the six culture phases in chronological order in Figure 4.

It has been shown in the foregoing discussion that the peculiar and distinctive variations in the styles of harpoon head ornamentation stand as diagnostic criteria of cultural changes in the Alaskan Arctic. The Eskimo art periods have been briefly treated, as this thesis is primarily concerned with the establishment of a Qiviut knitting industry. Prior to

Figure 4. Alaskan Eskimo art periods*

		BERING STRAIT	NORTHERN ALASKA
A.D.	1900	CONTEMPORARY	CONTEMPORARY
	1700		
	1500		
	1300	WESTERN THULE	WESTERN THULE
	1100		
	900	PUNUK-BIRNIK	
	700		BIRNIK
	500	PUNUK	
	300	CLASSIC OLD BERING SEA	(?)
	100		
		OLD BERING SEA	IPIUTAK
B.C.	100		
	300	OKVIK	
	500		NEAR IPIUTAK

*Composed after Bandi (1969) and Ray (1961)

the first village workshop to give instruction in knitting with Qiviut, a pattern was devised from a design based on a Punuk style harpoon head.

h. Harpoon design interpreted for knitted pattern

The geometric patterns inscribed on utilitarian and ceremonial objects of ivory provide innumerable motifs suitable for translation into knitting patterns. Of the myriad possibilities represented in the University of Alaska's Eskimo artifact collection, a very simple Punuk ivory harpoon head was selected. The rather crudely incised lines suggested a very interesting interplay of geometric shapes arranged in asymetrical progression. Figure 5a is a sketch of the two sides of the harpoon head.

Transfer of ornamentation from one medium to another is restricted only by the artist's imagination and the technical requirements of the new medium. In this case, a transfer was made of a design etched on ivory to a pattern using Qiviut yarn in knitting. To reproduce the motifs suggested by the lines inscribed by the ancient Eskimo carver on the ivory harpoon head required a technical command of restrictions imposed by knitting technology. The intermediate design step between the inspirational artifact and the final knitting pattern is represented in Figure 5b. A simple arrangement of a series of geometric figures recur in regular order as a result of translating the harpoon's etched lines and inner form to a two dimensional design.

At the bottom of the design, an 'X' shape gives rise to three chevrons which enclose a diamond shape for the final geometric form.

Within the diamond shield may be seen a heavy vertical line which represents the slot in the top of the harpoon head carved out for insertion of the blade. An ornamental band of double holes serves the dual purpose of limiting and enclosing the decorative field, while the smooth marginal field in stockinette stitch functions as a border, setting off the central decorative panel.

The final step in this creative process is to transcribe the arranged shapes forming the design into a pattern within the technical limitations of knitting. Rather than attempt knitting instruction based on traditional, written directions of cryptic English abbreviations, a newly published system of charted, knitting symbols was adopted. It was believed that the use of Mrs. Dorothy Reade's original shorthand system of knitting notations would enable language difficulties to be more readily overcome. Her knitting symbols have been copyrighted since 1968.

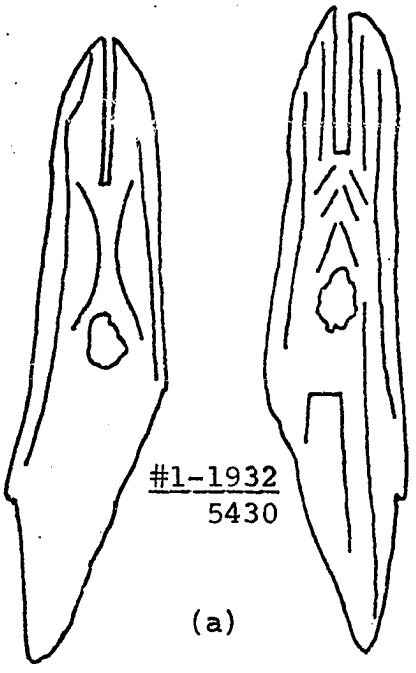
The basic geometric shapes are outlined by use of the open, 'yarn-over' stitch, symbolized by a filled circle, '●'. A basic principle in designing a knitted pattern to be formed by holes created with the use of the yarn-over stitch, '●', is to compensate for each such stitch with a 'knit-two-together' stitch. Also important is the placement and direction of the 'knit-two-together' stitch as it can be used either to outline a motif or to form curved areas. This compound stitch may be made either through the back of the loops or the front to give the effect of either a left slant or right slant, respectively, and is charted '\', '/'. Rather than being limited to only a 'knit-two-together' stitch to compensate for the addition of every 'yarn-over' stitch. The 'slip-stitch, knit-two-together, pass-slip-stitch-over', designated by the

symbol '∧', can be used to adjust for the use of two, 'yarn-over' stitches. Furthermore, the 'yarn-over' stitch requires that if the stitch above it in the next pattern row is a knit stitch, it must be knitted through the back of the loop to give a clearly defined outline. This 'knit-though-the-back-of-the-loop' is charted as 'B' (Reade, 1968). Figure 5c is the resulting knitting pattern charted with Mrs. Reade's symbols. By mentally connecting the filled circle symbols, the geometric motifs can be clearly seen. Figure 9a also shows a photograph of this pattern as an handknitted Qiviut scarf.

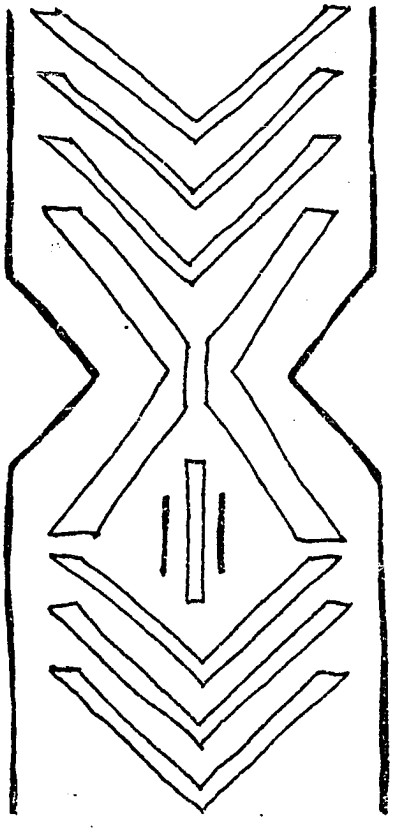
An established knitting industry among aboriginal peoples is not without precedent. Lane (1951) has shown that the Cowichan knitting industry, inadvertently begun by Orkney fishermen in the late eighteen hundreds, has had far-reaching social and economic consequence. She has further stated that the Cowichan knitting industry represents a fairly widespread and intensive effort on the part of the Coast Salish groups to make an economic adjustment to living under a foreign administration. In the twenty years since Lane did field work on the Cowichan knitters, their famed sweaters and other handknitted accessories have continued to be in demand internationally.

Having completed research into a knitting industry among other aboriginal peoples, and with an Eskimo art inspired knitting pattern in hand, I was prepared to undertake the final phase of this project. The first Eskimo Qiviut workshop is the subject under discussion in the following pages.

Figure 5. (a) Sketched ivory harpoon head (b) Design motif
(c) Knitting pattern



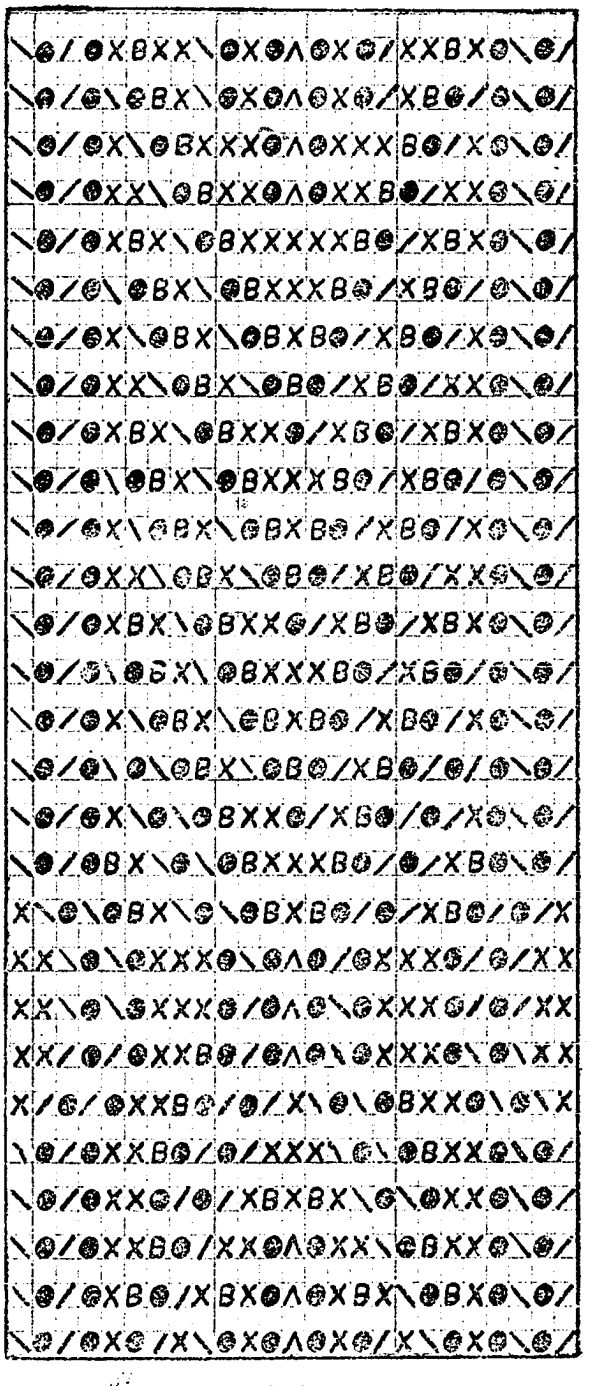
(a)



(b)

X=Knit □=Purl B=Knit through Back of stitch
●=Yarn over (bring to front between needles)
/=Knit 2 together through front of stitches
\=Knit 2 together through back of stitches
Λ=Slip 1 stitch, knit 2 together, pass slip st. over

'Mekoryuk single harpoon'



(c)

Chapter IV

FIELD WORK AT MEKORYUK

ON NUNIVAK ISLAND

a. The Village of Mekoryuk

Across the Etolin Strait from the Yukon-Kuskokwim lowland of southwestern Alaska lies Nunivak Island. This island is one of several islands that are part of the Bering Platform and rise above that submarine plain. The climate of the island is affected primarily by the surrounding Bering Sea. A recent visitor to the island, while on a musk ox capturing expedition for I.N.A.R., writes the following description:

> The Bering Sea is little more than a great bay of the Arctic Ocean, and both its Alaskan and Siberian coasts, laid bare of trees by permafrost and wind, are polar in their composition. It is the meeting of Arctic waters with warm air masses from the Pacific that breeds the chronic overcast and fog, and hides from view an island which, in a more temperate place, would be one of the most beautiful in all the world (Matthiessen, p. 7, 1967).

More specifically, the island's high domes are centrally located with small buttes, hills and craters rising above a plain elevation of about 500 feet. Roberts Mountain, Nunivak Island's highest point, stands 1675 feet above sea level. On the west coast the shoreline is more abrupt, with bluffs rising from the sea to 100 to 200 feet. On the east the rise to the interior elevations is more gradual, beach bluffs being under 50 feet. Throughout, the island is tundra-covered and dotted with small lakes. Dune lines in the south support sparse stands of beach rye grass (FFCDPA. p. 108, 1968).

The Nunivak Island National Wildlife Refuge insures preservation of habitat for musk ox, for the larger colonies of sea birds, and other forms of wildlife present on the island. Semi-domestic reindeer now replace caribou, which became extinct on Nunivak near the end of the last century. The management of these varying wildlife forms is shared by

the Bureau of Sport Fisheries and Wildlife and the Bureau of Indian Affairs. The village use of land is complicated by the regulatory authority of these agencies administering the refuge. The Nunivak Island Wildlife Refuge does not prohibit subsistence use, but its purpose requires protection of birds and musk ox within the reserve.

As early as 1874 the U.S. Coast and Geodetic Service reported a summer camp located on the site of present day Mekoryuk. Today this is the only year-round occupied village on the island. The other traditional village sites are popular summer fishing camps, but are abandoned in the fall when it is time for the children to return to school. This Eskimo settlement on Nunivak is located southwest of Cape Etolin, on the north coast; its harbor is formed by the mouth of the Mekoryuk River.

At the time of my visit, December 1968, Mekoryuk had a population of approximately 270 according to the Bureau of Indian Affairs (B.I.A.) records. The population was composed of 46 families, including 65 women over 16 years old. The white segment consisted of three B.I.A. teacher couples, the principal teacher's four children and one halibut fisherman, who was married to a native of Eek (a Kuskokwim Delta village) and their child. Additional white contact is limited to the time of the reindeer slaughter when two or three whites reside there temporarily and to occasional visits from Fish and Wildlife biologists or health personnel.

The community complex consisted of a Swedish Covenant Church, the Mekoryuk Native Store, Post Office, Recreation Hall, the Reindeer Project buildings, the B.I.A. school facilities, as well as a varied assortment of village homes, storage sheds, outhouses and drying racks for fish or skins. Remnants of the old style semi-subterranean homes blown clear of

snow could be seen. Since the 1940's, all new homes have been frame buildings constructed above ground. They have a certain charm of weathered wood and fading painted trim. The half dozen pre-fabricated houses most recently built foretell a prosperous village of larger, more modern homes emerging.

During my visit, the pastor of the Swedish Covenant Church was Mr. Dana Kopanuk, a mainlander from Hooper Bay, who conducted most of the church service in Eskimo but read the scripture in English first. His wife, Anna, from Mountain Village, assisted Dana in all aspects of church work. Throughout the week Mr. Kopanuk clerked in the Native store.

The Mekoryuk Native store, the only store in the village, was managed by Mr. Jerry David. The villagers' needs, which are wide and varied, are supplied by this facility. Fox skins, Nunivak masks and other craft items were accepted in trade and available for resale. Although there was still a great reliance on fish in the village diet as well as on reindeer meat, a noticeable shift was occuring from a subsistence diet to one supplemented by store food which requires an income.

The Reindeer Project, in December 1968, had one full time Mekoryuk employee the year around, who was Mr. Rex Mathlaw. At that time it was administered by the U.S. Department of Interior. During the fall round-up many villagers were hired to drive the reindeer and to assist in the slaughtering process. The Nunivakers were permitted by Fish and Wildlife to kill five reindeer per family per year, and were charged a nominal fee per animal. A reindeer may yield from 50 to 75 kg of meat. Its hide may be made into mitts and tutuluks (boots) with the hair on, for home use, or tanned and converted into gloves, for the tourist trade. The antlers

are used also.

The Bureau of Indian Affairs' school facility included three buildings; the school-house proper with classrooms, multi-purpose room, kitchen and guest room; the power plant building for maintaining the complex; and the old schoolhouse, which had been converted into three apartments. The principal teacher was Mr. Dale LeFevre who, with his wife and two other teacher couples, provided education for beginners through eighth grade, or from age six to sixteen. The B.I.A. Day School employed a cook, a teacher's aide, general maintenance man and a janitor from Mekoryuk. There was also a Headstart program for twenty-three students, aged three through five, operated by the State with Federal funds from the Office of Economic Opportunity and administered by the Village Council. The Headstart program had been in operation since the fall of 1966.

Sources of income other than those already referred to included relief checks, and food stamps, generally utilized by the older persons of the community, and the National Guard. This latter source enables the young men of the village to receive a few dollars for attending local meetings and about $200 when attending winter camp outside Anchorage. Seal hunting, fox trapping, making crafts for the tourist trade are traditional sources of income still pursued.

In general, the Nunivak Islanders exhibit ambition. Besides the several older craftsmen, some of the younger men and boys know how to carve ivory and driftwood and will do so when a monetary return is assured. The women still weave baskets of grass and do traditional skin sewing. Mekoryuk seems to have a more stable economic base than the

Kuskokwim River area villages as reflected by better health and a cleaner village, according to several sources. Nunivakers seem to feel themselves above mainlanders by reason of their better homes, more fluent English, more stable economy and physically larger men on the island.

One last aspect of influence on the people of Mekoryuk should be considered, and that is the musk ox. These animals, established on their island in 1936, are regarded with fear and with possessiveness. At every opportunity the islanders collect the wind-strewn wild wool - as when out fishing or berry picking. The Nunivak islanders appear greatly determined to cash in on this resource of their island.

b. Daily field notes

Friday 20 December 1968

When my flight to Nunivak Island was re-scheduled after a four-day delay in Bethel, due to a typical mid-winter Bering Sea storm, I joined the eager Eskimos boarding a large, orange twin Otter to return home for the holidays. After crawling over fluorescent orange mailsacks, bulging with Christmas packages, and settling into the one remaining seat, I recognized the woman seated across the aisle as Mrs. Katie Tootkaylok, whom I had met at the Musk Ox Project office in Fairbanks. Over the roar of the revving engines, she introduced me to her nieces, Mrs. Hilma Shavings, the wife of the Mekoryuk Wien radio operator and Miss Alice Hendrickson, a University of Alaska student. As we flew over the vast Kuskokwim River Delta country with the sun glinting off frozen river meanders, we each got out our knitting and turned to our own thoughts.

Mail and passengers were first delivered at the isolated villages of Toksook and Tununak on wind-swept Nelson Island before crossing the forty miles of ice-choked Etolin Strait to land finally at the Mekoryuk airstrip. The village was not visible from the airstrip, which was carved out of snowy desolation. Although I had seen nothing but snow-mobiles used for hauling mail and a passenger sled on Nelson Island, here a snow-plane provided passenger transportation. It looked like a water beetle, powered by an air fan, as it skimmed over the snow on tri-skis. Because of my status as a "gussak" or white person, I was delivered to the school house rather than to the house of the Village Council President, Mr. George King, as I had requested.

Entering the school, I introduced myself to the principal teacher, Mr. Dale Le Fevre. As he had delivered the telegram informing the Village Council President, Mr. George King, of my original arrival date, Mr. Le Fevre understood the situation and got in touch with Mr. King on his return from reindeer hunting. Mrs. Olene Le Fevre took me to the Kings' house where I met Mrs. Margie King, who informed us that her husband had planned to stop by the post office before coming up to the school. We returned to wait for him at the school house. This first visit to a village home was slightly confusing, but did reveal that these small houses were unequipped to put up a guest.

When Mr. King arrived at the school house, he suggested that, with all the Christmas preparations and practice going on at the church, the school guest room was the best place for me to stay and hold the Qiviut Workshop. Mr. Le Fevre concurred and readily offered the B.I.A. guest facilities for my use. After showing Mr. King the machine-spun scarf I

was knitting and a handspun one which he especially liked, I handed him a sample of raw domestic fleece to compare with the feel of wild musk ox underwool gathered from the tundra. He informed me that the Village Council had applied to a Federal economic aid program for funds to acquire spinning machines to make yarn from all the musk ox wool which the villagers collect assiduously.

Before leaving the school, Mr. King informed the 4-H girls, who were arriving for their Christmas party, that I was there to give a Qiviut Knitting Workshop. They were requested to tell their mothers about the first meeting scheduled for the next morning. Mrs. Le Fevre included me in the 4-H Christmas party which enabled me to meet the girls and show them my Qiviut knitting. After telling them I was from the Musk Ox Project at the University of Alaska, I explained that at the Workshop their mothers could learn a new type of lacy knitting with Qiviut yarn which would enable them to earn additional income. I invited the older girls to come and learn how to knit also.

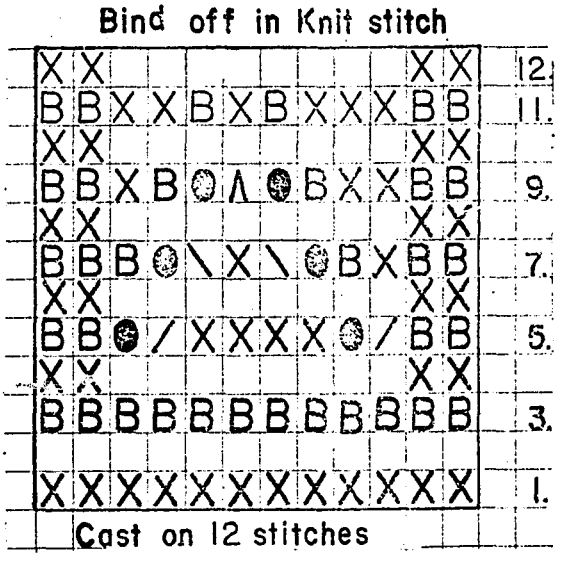
Saturday 21 December 1968

All meetings of the Workshop were held in the school guest room. Three women, two older girls and a teacher, Mrs. Gail Ribich, were the first to come. To illustrate the type of knitting that I would be teaching, I showed them both the handspun and the machine-spun scarves as well as the samples of fleece from a domestic musk ox. I then handed out the sheet of instructions for the first sample pattern (Figure 6a), 4-ply knitting yarn and size 7 needles. Three more women who arrived just then were also included. My teaching method involved sitting on the rug,

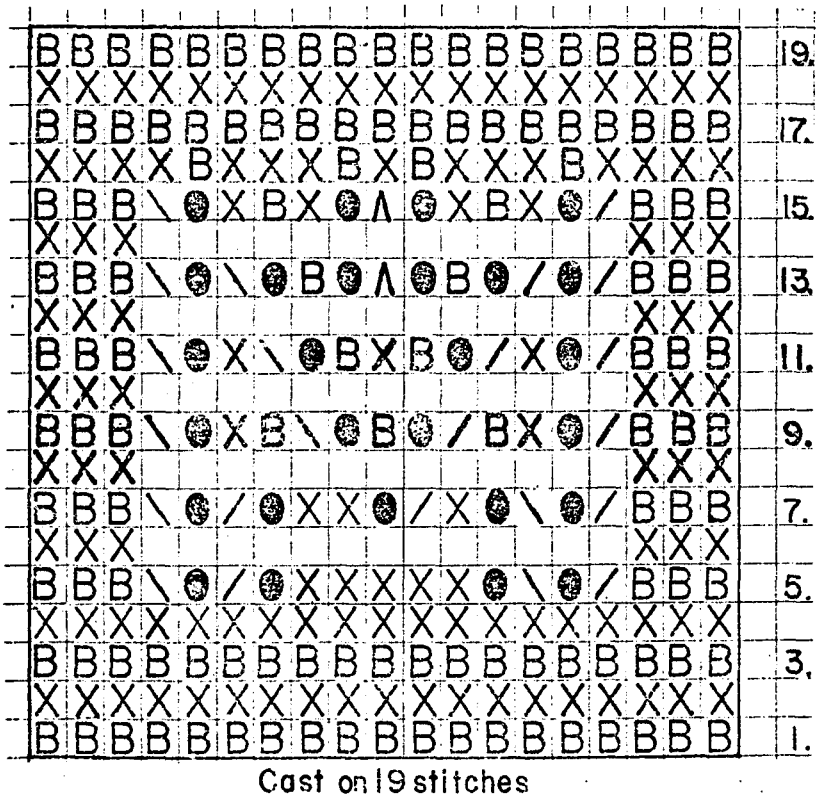
Figure 6. Instruction sheet for first and second samples

(a) Sample 1: Size 7 needles and 4 ply yarn

X = Knit □ = Purl
B = Knit through Back of stitch
/ = Knit 2 together through front of stitches
\ = Knit 2 together through back of stitches
● = Yarn Over (bring to front between needles)
Λ = Slip 1 stitch, Knit 2 together, Pass slip stitch over



(b) Sample 2: Size 5 needles and 3 ply yarn
Bind off in Knit stitch



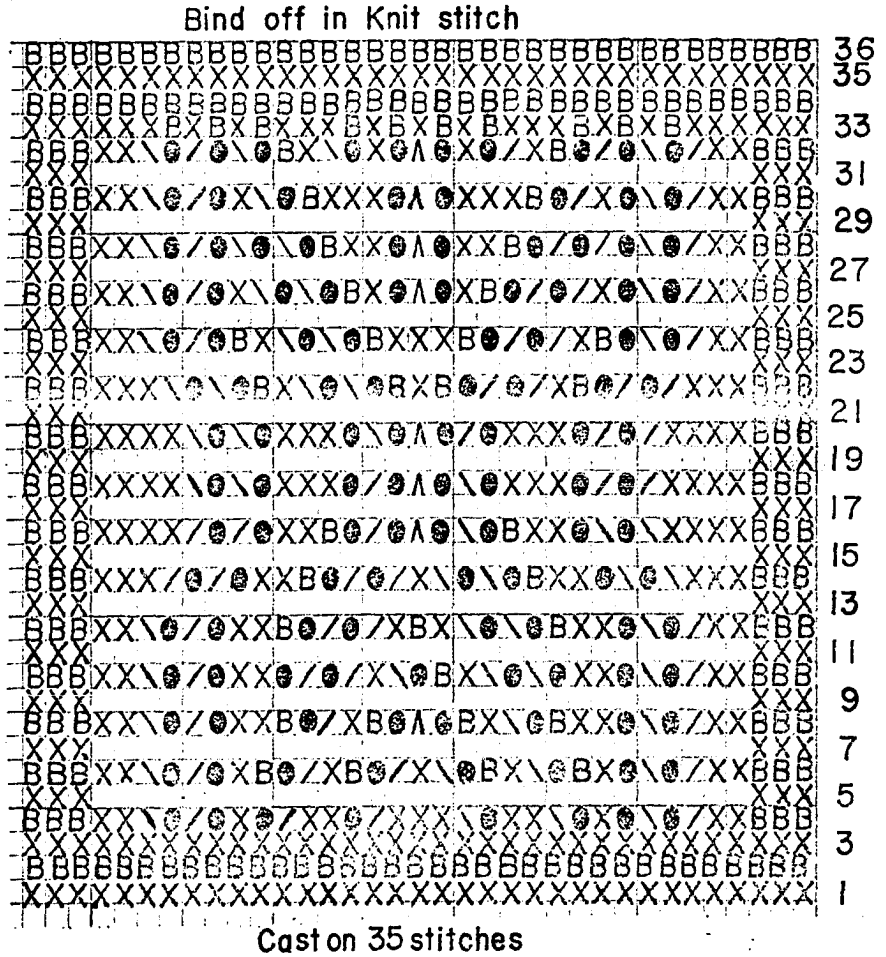
as some of them were doing, knitting each stitch to show how it was made and pointing out that it looked like the symbol on the pattern sheet. They all completed the first small sample before leaving. Some of the women took it home to repeat before coming for the second practice session. Arrangements were made for an evening session after the women's volleyball game, to knit the second practice sample (Figure 6b).

A young Eskimo woman, Miss Hannah Jones, and four Eskimo girls came for knitting instructions after the older women went home. Of the girls, the older two, Alma Rose Shavings and Elena David, showed potential but were called home to help before they could complete the first lesson. Mrs. Gail Ribich later said that she would try to help them with the open style of knitting when they had more free time available after the Christmas holidays. The two younger girls had never knitted before, so I just showed them the basic knit and purl and suggested they practice a lot before trying anything more complicated. Hannah stayed until she had finished the first and second sample patterns and had started on the Qiviut sample pattern (Figure 7). The duration of the first meeting was from mid-morning to late afternoon. Mrs. Ribich took photographs during the instruction in order to cause the least interruption (Figure 8a).

After supper I watched the women's volleyball game held in the school multi-purpose room and continued working on the handspun Qiviut scarf which I had been knitting while on the plane leaving Bethel. Nine women came to the guest room for the continuation of the workshop after the game, four of them had not had time earlier in the day or became interested during the game because they saw what I was making. The new women started on the first pattern sample and the other five women worked

Figure 7. Instruction sheet for sample knitted from Qiviut yarn
Sample 3: Size 3 needles

X = Knit □ = Purl B = Knit through Back of stitch
/ = Knit 2 together through front of stitches
\ = Knit 2 together through back of stitches
● = Yarn Over (bring to front between needles)
Λ = Slip one stitch, knit 2 together, pass slip stitch over



with the second sample pattern. The second meeting lasted from 8:30 p.m. until 10:15 p.m.

Sunday 22 December 1968

Following the boardwalk, I joined several Eskimo families responding as I was to the ringing church bell on Sunday. In brief snatches the sun lighted their colorful parkas while the winter wind rippled the fur ruffs surrounding their glowing faces. As we filed into the simple, pine-paneled church, its roof supported by laminated beams, I met one of the knitters, Miss Hannah Jones, who invited me to sit with her. After church, she took me to her sister's house.

While there, her Aunt offered me some 'akutag' made from salmon-berries whipped with shortening and wesson oil. It had a tart taste to it like cranberry relish and I liked it. The three adults and several children were eating dried tomcod that had been strung on twisted grass to dry. There was also a dried dog salmon on the table. This visit enabled me to observe more about the people.

That afternoon, from 2 to 5:30, four women stopped by to continue the knitting Workshop. They finished the second sample pattern and three of them started the Qiviut sample pattern which they took home to finish. Hannah had stopped by just to visit for a few minutes. One of the women had arrived to knit only as the others were leaving.

Later that evening, I visited Katie Tootkaylok to see her spinning wheel. It was early American style, painted mustard color rather than having a stained wood finish. The tension device for the wheel belt was not a traditional style. Katie let me take a few pictures of her spin-

Figure 8(a). Eskimo women knitting the first sample lesson of the Mekoryuk Qiviut Workshop, December 1968. Photo by Gail Ribich.

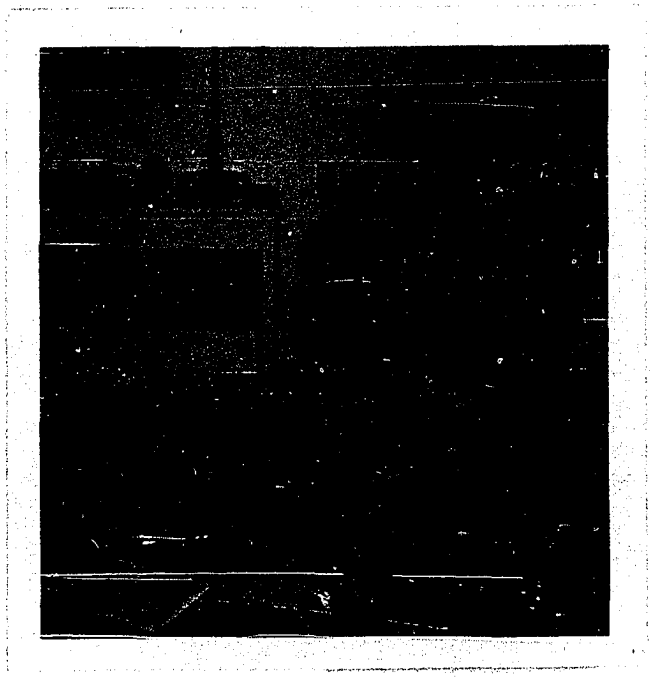


Figure 8(b). Katie Tootkaylok of Mekoryuk spinning wild musk ox wool. Photo by author.

ning and carding the wild musk ox wool she had picked up on the island (Figure 8b). We then had tea with her mother and step-father, her sister and brother-in-law, Nancy and Bob Edwards of Bethel, and her niece, Alice Hendrickson, whom I'd met on the plane.

Katie's mother, Pansy Jones, who at 86 is the oldest woman in the village, showed me two carrying bags she had made in the traditional style of the grass carrying bags but twined from polypropylene rope instead of grass. To prepare this substitute material, she untwined the polypropylene rope gathered from the island's beaches after washing ashore from the Japanese fishing operations in the Bering Sea. After tea and conversation I left, returning to the schoolhouse in case anyone stopped by for more knitting instruction.

Monday 23 December 1968

After reviewing the village respondents and knitting material covered during the weekend, I began typing my address and direction on the back of the third sample pattern sheet. This was the sample to be knitted in Qiviut before a knitter actually started a scarf. Five copies of each lesson were put into plastic bags for Katie Tootkaylok and Gail Ribich. Katie had offered to help other village women and Gail would instruct the older girls. Next came my daily walk to the Native store.

While at the store I talked to a young woman who had come on Saturday to the Workshop with her two babies. Unfortunately it had been too crowded for me to instruct her before she left. She was glad to hear that Katie Tootkaylok had copies of the pattern lessons and would help her after Christmas. Mr. George King also happened to be there, so we

discussed the Village Council's collection of 200 lbs. of wild musk ox wool from the village people, which they wanted machine spun into yarn. I described the special cashmere machinery required to process the underwool and promised to talk to Mr. Teal about the idea.

In the afternoon Mrs. Molly Hendrickson came with her small son Erik and finished the second sample pattern in about 45 minutes. From 4:00 to 5:15 Katie Tootkaylok and her sister, Mrs. Nancy Edwards, came to knit. Nancy did the first sample pattern while Katie gave her instructions in Eskimo. While the three of us were knitting and having coffee, Katie finished the third sample in Qiviut and started an actual scarf. She used the pattern I had been using to knit a handspun Qiviut scarf, because all the other scarf patterns were in my suitcase, which never arrived from Bethel. I arranged with Katie that when she had knitted the domestic Qiviut into a scarf, she would then knit the same pattern with her own handspun wild musk ox wool.

Tuesday 24 December 1968

In the morning I visited Mrs. Margie King while she was babysitting at the Le Fevres'. She was working on the third sample pattern in Qiviut and was about ready to begin a scarf. Before leaving, I gave her more Qiviut yarn to start a scarf and also asked her to take yarn and the third pattern to Mrs. Eula David.

On my way to the store that day I took a number of pictures of the village. There were half a dozen newly constructed pre-fabricated homes; two or three of the old, semi-subterranean houses now used for storage; and one two-story home where the pastor and his family lived. Most of

the homes were constructed since 1940 from a variety of materials and along individualistic lines, small, but snug and warm looking.

Mr. Larson King came to the school to interview me in his capacity as Secretary-Treasurer for the Village Council. (He appeared to be a confident individual who had worked on the mainland for the B.I.A. in some capacity.) His questioning concerned the aims of the Musk Ox Project for the Nunivak wool. In response to these and similar questions, I answered that the Project's aim was to provide an economic source for the village through knitted products of machine-spun, domestic Qiviut. I stressed the fact that I didn't know what Mr. Teal had in mind for the Nunivak wild wool. Showing him the domestic musk ox fleece for comparison, I remarked that the sandy, weather-harshened wild wool would require many tedious hours of hand-sorting, cleaning, hand-carding and spinning before it was suitable for use in bulky, outdoor wearing apparel.

I did not think they had collected sufficient poundage for commercial processing. After explaining in detail the machine spinning process, he seemed to be satisfied on that score. After outlining my previous textile experience before coming to Alaska, I told him that now, as Textile Specialist for the Musk Ox Project, I was working on a Master's degree at the University of Alaska. My research with Qiviut consisted of spinning, designing knitting patterns and apparel, and experimenting with natural dyes. This information concluded the interview.

Following lunch, Mrs. Eula David brought back the first sample pattern saying she had been too busy with school and the church Christmas program preparations to finish. I told her that Katie Tootkaylok had

all the sample patterns and would help her knit them when there was more time after Christmas. Next Mrs. Lydia Weston stopped by to pay the 50 cents for the size 3 needles along with Mrs. Elsie Williams who had completed the first sample pattern. As she had a poor command of English she said she could not read the pattern, but I gave her the yarn and needles for the second sample pattern and encouraged her to get help from Katie Tootkaylok.

For the Sunday School Christmas Eve program, the men and older women recited scripture and sang a Christmas carol in Eskimo while the youngsters performed in English. According to village custom, everyone brought all their presents for each other to the church for blessing before being handed out by the village fathers. This lasted for over three hours as both wings of the sanctuary were heaped to the ceiling with assorted gifts. Some were wrapped very fancily and others simply in brown paper bags. Not only were candy and other goodies received, but also rifles, three skidoos and about a dozen children's sleds. Even the teachers and I received a few remembrances for Christmas.

Wednesday 25 December 1968

Mr. and Mrs. Le Fevre invited all the teachers, the pastor, Mr. Dana Kopanuk, his family and me for a turkey dinner. Walking back to the school house afterwards, I took pictures of the village. On the way I met Emily Baker who paid for her knitting needles. My Christmas day ended after the evening Nativity program at church.

Thursday 26 December 1968

At first light, I went to the store. While there, the pastor, who

clerks during the week, invited me to stop at his house to have coffee with his wife, Anna. She expressed an interest in the open style of pattern knitting, but, having a detergent rash on her hands, she had been unable to attend the Workshop. I showed her how each stitch was formed and looked like the symbol on the pattern sheet.

I then returned to the school to be there if anyone came to knit. Hearing that there might be a mail plane coming to Mekoryuk, I gathered my workshop material together and boxed up my Christmas purchases. Anna Kopanuk stopped by after the school lunch period to give me a belated Christmas gift. This visit enabled me to supply her with the three sample patterns to knit when her hands healed. Hannah Jones stopped by to get my address and paid for her knitting needles.

Before I had time to say goodbye to the teachers, Mrs. Hilma Shavings came to inform me that the bus was leaving for the airstrip. She and Lincoln Shavings helped carry my handbags to the open air, shortie school bus which took the eight passengers for Bethel to meet the mail plane.

When the Skyvan was finally loaded with mail and assorted cargo, including reindeer meat and passengers, it lifted off for Bethel. There, after much delay, I was able to make connections to Anchorage and returned to Fairbanks the morning of December 27.

c. Résumé of instructional procedure

The purpose of the field work undertaken in Mekoryuk on Nunivak Island was, not only to introduce a new type of knitting designed for

Qiviut yarn, but also for me to acquire village experience and to test teaching procedure. The proposed method was to use a symbolic system of stitch notation combined with the use of three practice samples. Each sample required successively smaller-gauge needles and finer yarn, with the final practice square knitted from the ultra-fine Qiviut which would ultimately be used for scarves. The plan had been to work with family groups for classes, over a period of a week and to actually have each knitter undertake the beginning of a scarf before leaving the village.

The beginning Qiviut Workshop was scheduled in early December. Arrangements were made with the Village Council via B.I.A. radio contact. Once they had accepted the offer of a knitting workshop and set dates for it, a confirming telegram was sent by Mr. John Teal, Director of the Musk Ox Project. I also sent a letter to the Village Council President, Mr. George King, requesting his aid in making living and working arrangements. Due to travel delays, I did not arrive in Mekoryuk until the 20th of December.

Plans had to be revised to fit the special circumstances of the Christmas season. In actual experience, it was not possible to schedule session times in advance. Aside from the first meeting, set by Mr. George King, the successive knitting meetings were arranged at the convenience of the village women present. An informal approach to instruction seemed to best fit the situation. Only by sitting on the floor with two or three women at a time was a clear demonstration possible. Each pattern stitch, knitted according to the symbol on the pattern sheet, was then easily and immediately understood. The system of sample patterns with the graduated use of needles and yarn size was apparently successful.

Only one participant began knitting a scarf by the conclusion of the Workshop. The Workshop had consisted of three days of actual instruction to cover the material. Arrangements were made to have each knitter send her completed Qiviut sample, the third practice pattern, to the Musk Ox Project at the University of Alaska. Upon receiving this proof of their ability and interest, enough Qiviut yarn was sent to each knitter for the completion of the first scarf. As set forth in the previous section, the scarf pattern designed exclusively for Mekoryuk was inspired by a Punuk ivory harpoon head from the University of Alaska Museum collection.

When a scarf was completed, the knitter mailed it to the Musk Ox Project for inspection and by return mail received payment with more Qiviut yarn for her next scarf. Many more women requested to undertake Qiviut knitting instruction during the months following the initial workshop and by correspondence completed the required sample work. Examples of this correspondence with the women of Mekoryuk are included in Appendix 2.

d. Analysis of workshop results

It was imperative to obtain data on the rate of production and the average size of each knitter's scarves before extensively marketing Qiviut scarves. This information would also determine the best method of distributing the limited supply of Qiviut yarn. In the ten months following the initial knitting instruction undertaken by the writer-researcher on Nunivak Island, monthly records were kept on the production of scarves; not only how many scarves per month were knitted, but also their dimen-

sions and weights were noted. These monthly records are reproduced in Appendix 3. At the end of ten months, a temporary suspension of yarn supply was put into effect until sufficient market demand warranted the resumption of Qiviut scarf production.

As has been noted previously, several women of Mekoryuk acquired the skill of knitting from Katie Tootkaylok and the eight others who completed the December Workshop. In eight months 21 additional knitters had completed Qiviut scarves. Individual production charts were kept on each of these 30 knitters and are included in Appendix 3.

For the first three months of 1969, all scarves were knit of 4-ply, 11-run Qiviut yarn spun by the Forté Cashmere Company of Boston. After March, 4-ply Qiviut yarn was discontinued, as a lighter weight, more lace-like effect was desired. For the remaining seven months of this study, the Qiviut was no longer double plied as it had been, but was supplied to the Mekoryuk knitters as 2-ply yarn.

To obtain the desired size of 12 inches (30 cm.) by four feet (122 cm.) changes in width and length were required. The original pattern was 55 stitches wide by four repeats long, which resulted in a scarf 12 inches (30 cm.) by 36" (91 cm.). Some scarves knitted with tighter tension were only 10" (25 cm.) wide. By return correspondence the knitters were requested to widen the scarf by casting on 65 stitches and to increase the length by knitting six and a half repeats. The half repeat was necessary for the design to begin and end with the same motif. One other change occurred during the months under discussion. During the first part of August the Mekoryuk harpoon pattern (Figure 9a) was changed

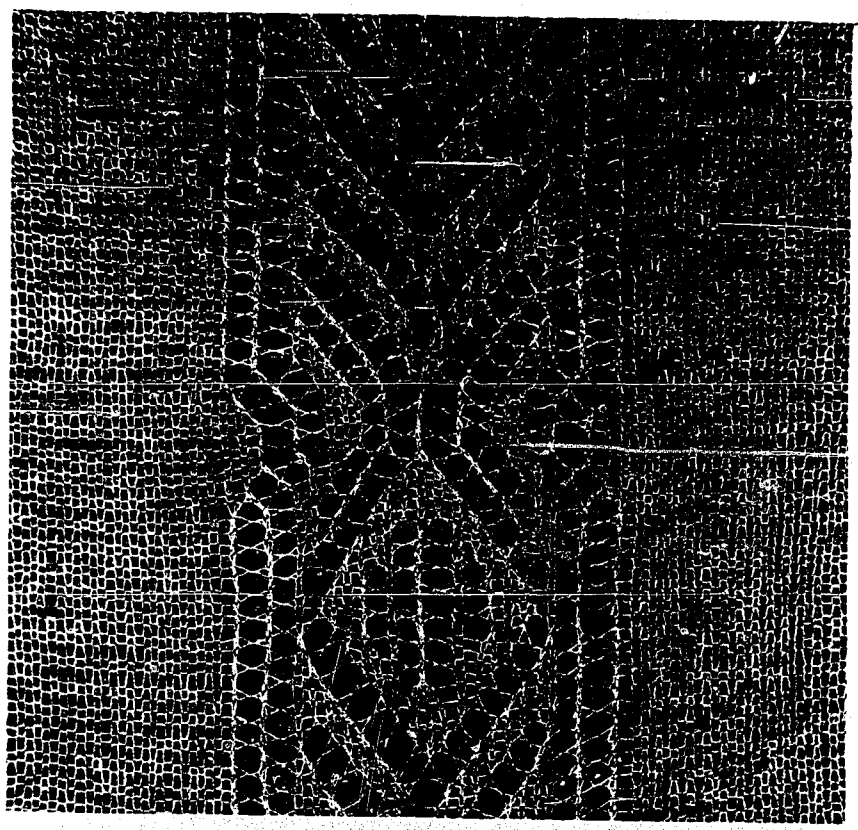
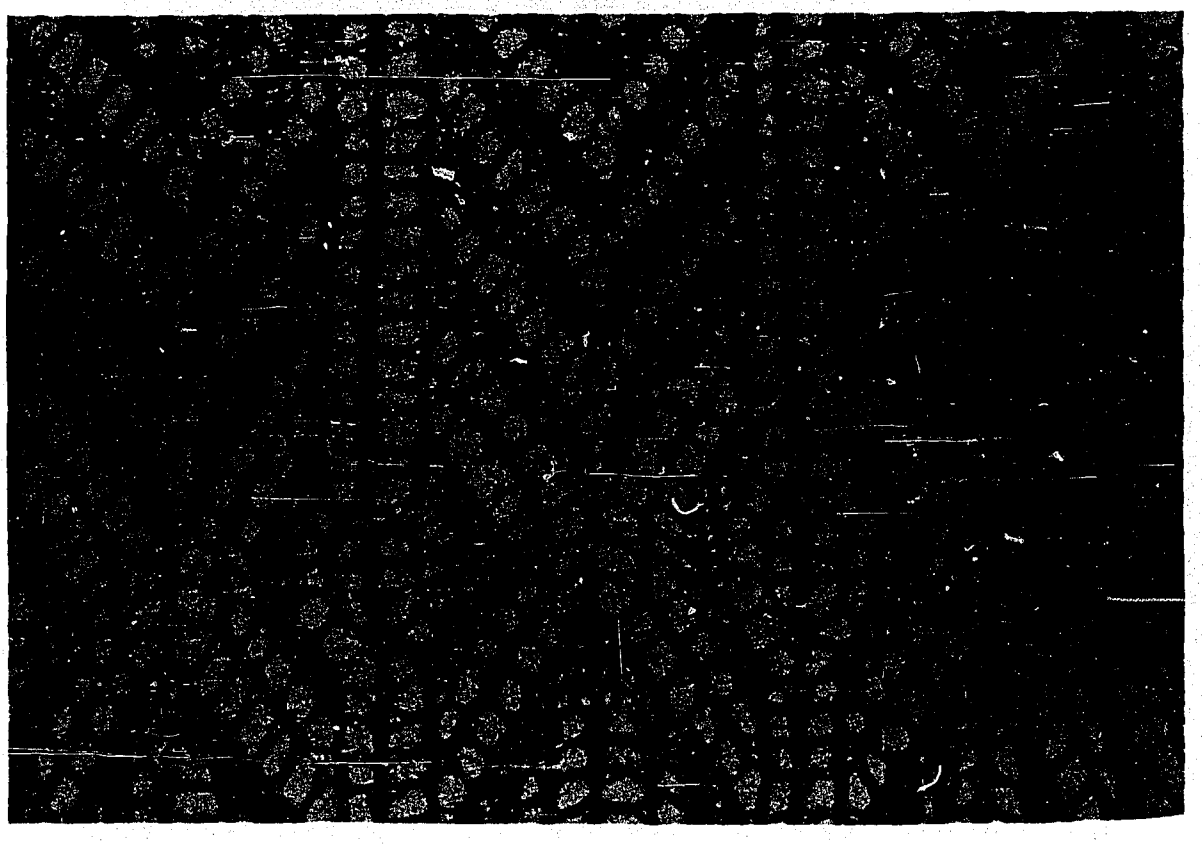


Figure 9(a).

Handknitted scarf in the single harpoon pattern

(b).

Handknitted scarf in the triple harpoon pattern



photography by Graham Dugdale

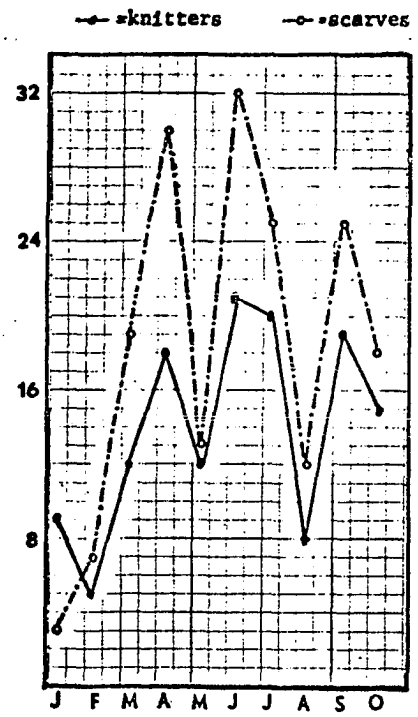
from a single, centered design panel to a wider, all-over pattern (Figure 9b). It was essentially the same design, but repeated as triple panels and henceforth called 'Triple Harpoon'.

It may be seen in Figure 10a that production was erratic. The months of May and August may be explained by events occurring in late April and early August. No Qiviut yarn was sent to the knitters in the last two weeks of April while the writer was on maternity leave. Then, in August, several weeks were required for the change over and re-acquaintence with the larger Triple Harpoon pattern, now 73 stitches wide.

A seasonal production curve can only be roughly estimated on the basis of Nunivak Island subsistence requirements and community activities. During the spring and summer months most Eskimo families are sealing, fishing and berry picking, which limits their spare time. Also during late August, the reindeer round-up and consequent processing for export, leaves little spare time for knitting. Following Thanksgiving, all community effort is focused towards the Christmas celebration and making of traditional Eskimo clothing for gifts. It can be theorized that from January through April would be the months best suited for knitting. This is not evident from Figure 10a however, since there were fewer knitters during these months. Another three years' worth of monthly records would be necessary for production estimations of any accuracy (Appendix 4).

The average rate of production, graphically shown in Figure 10b, seems to have been one scarf per month. This varied, however, from 16 scarves knitted in nine months by Mrs. Hilma Shavings to a first scarf knitted in ten weeks and two days by Miss Muriel Mathlaw in the Triple

Figure 10(a). Monthly production of scarves by the number of knitters



(b). Production of scarves by individuals per month

Name:	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.
Amos, Cecilia									*	*
Amos, Nona				**	*	**	*		*	
Andrew, Bertha				*		*		*	*	
Baker, Emily		*		***		*	*			
David, Eula							*			**
David, Rosie J.									*	
Davis, Irene				*		**	*			*
Float, Edith			*	*	*	*	*		*	
Hendrickson, Mollie			*	*	*	***	**			
Ivanoff, Gertrude						**	**	*	***	*
John, Dora				*			*			
Joshua, Nellie						**	**	***	**	**
King, Margie	*	*				*		*		
King, Rose				**	*	*	*		*	
Kiokun, Nan				***		**	**		**	*
Kolerok, Laura						*	*		*	*
Kopanuk, Anna		*	**		*					
Mathlaw, Alice									*	*
Mathlaw, Edna			***	***		**		*	*	
Mathlaw, Muriel									*	*
Olrun, Leah			*	***	*	**	*			*
Shavings, Alma			*	*	*	*			*	
Shavings, Amy					*		*			
Shavings, Ester			**	***	*		*			*
Shavings, Hilma	*	***	***	*	**	*	**	*	**	
Shavings, Susie						*	*		*	*
Spud, Elizabeth			*	**	*	*	*		**	**
Tootkaylok, Katie	*		*	*	*	***	*	***	**	*
Weston, Lydia	*	*	**	*		*	*			
Whitman, Lucy								*	*	*

Harpoon pattern (Table 5). The length of time to produce a first scarf averaged four weeks, not including the five knitters whose first scarf was knitted from the Triple Harpoon pattern. The highest percentage of women knitting scarves was in June. However, it was in April that the scarves produced were almost double the number of women knitting. In March, June, August and September the number of scarves knitted were half again as many as the number of knitters (Figure 10a).

When comparing the dates of yarn sent with dates of scarves received, it became obvious that within the village women were swapping yarn back and forth. This practice was verified from the knitter's correspondence as shown in Appendix G (Elizabeth Spud 9/24/69). At the end of ten months, the total weight of scarves received compared to yarn sent, showed only a 5% loss of yarn. This is a small amount and is to be expected with knitting.

Among the scarves returned for correction, the most common mistake was casting the stitches off too tightly. Only five of the total 188 scarves knitted from January to October were returned for pattern correction in the design, while 29 were returned for re-binding off to make the scarf saleable.

Actually, no meaningful conclusions can be drawn from these ten months' production figures due, not only to the changes in pattern taking place and increasing number of knitters, but also to the innovative nature of the industry introduced. What is significant is the response of the Mekoryuk women to training and to the opportunity of earning supplemental income. Utilization of Mrs. Reade's symbolic stitch notations did prove effective for instructing women with a limited command of English.

Table 5. Production rate of Qiviut scarves per knitter.

Name	Knit Time First Scarf	Total No. of Scarves	Total Time Knitting	Avg. Time per Scarf
Amos, Cecilia	4 1/2 wks.	4	3 mo.2 wks.	3 wks.5 dys.
Amos, Nona	2	7	5/2	3-0
Andrew, Bertha	3	4	4/0	4-0
*Baker, Emily	3	6	4/1	2-6
*David, Eula	6	3	5/0	7-2
David, Rosie J.	7	1	1/2	7-0
Davis, Irene	3 1/2	6	4/0	2-4
Float, Edith	2	9	7/2	2-8
*Hendrickson, Mollie	10	8	6/0	2-2
Ivanoff, Gertrude	2	9	5/0	1-6
John, Dora	3 1/2 wks.	4	2 mo.1 wks.	4 wks.6 dys.
Joshua, Nellie	2	11	5 0	1 5
*King, Margie	4	5	7 0	4 6
King, Rose	4	6	6 1	3 4
Kiokun, Nan	2 1/2	10	6 0	2 1
Kolerok, Laura	3	4	5 1	4 5
*Kopanuk, Anna	4 1/2	4	3 1	3 1
Mathlaw, Alice	8	2	2 2	5 6
Mathlaw, Edna	1	10	5 0	1 4
Mathlaw, Muriel	10 wks.	2	3 mo.3 wks.	7 wks.5 dys.
Olrun, Leah	5 1/2	10	8 2	3 2
*Shavings, Alma	2 1/2	5	7 1	5 1
Shavings, Amy	4 1/2	2	3 0	5 1
Shavings, Ester	3 1/2	8	7 1	3 4
*Shavings, Hilma	2	16	9 0	1 6
Shavings, Susie	2	4	4 3	4 5
Spud, Elizabeth	3	9	7 3	3 0
*Tootkaylok, Katie	2	14	9 3	2 3
*Weston, Lydia	3	8	10 0	4 6
Whitman, Lucy	7 wks.	3	3 mo.0 wks.	4 wks.1 dys.

*Original Qiviut workshop participants

From the instruction through correspondence with Mekoryuk, a more streamlined approach proved feasible and was then employed in subsequent village workshops. Rather than three sizes of needles and three separate practice patterns, only two of each proved necessary. First the use of size 5 needles and then size 3 as required to knit the finer Qiviut yarn were sufficient. However three sizes of yarn were still necessary. 4-ply yarn for the first lesson pattern then both 3-ply fingering and Qiviut yarn for the second pattern. The initial instruction remains the introduction of the basic eight stitches. The second practice square, 33 stitches by 33 rows, usually is based on the exclusive design for each village and is first knitted in fingering wool. The fingering wool is easier to handle and enables the novice knitter to become acquainted with her village design before undertaking the more rare Qiviut yarn.

In knitting, as in the traditional ivory or wood carving, basketry or skin sewing, complete automatic control of the technique involved results in regularity of form and of surface pattern. The Eskimo women of Mekoryuk are producing a masterpiece of handiwork which represents the transition they are making from a subsistence economy to a wage earning economy with pride.

SUMMATION

The objective of the foregoing field work was to ascertain the suitability of the method of village instruction chosen. This initial Workshop was to lay a foundation for more extensive future workshops. In addition, all possible effort was made to train knitters and obtain Qiviut scarves produced by Eskimos. Both of these endeavors met with results of some importance.

The scarves produced by the Mekoryuk women are proof that a village knitting industry utilizing domestic Qiviut can be established. Not only have the women been earning supplemental income, but they have been creating a beautiful, handcrafted item suitable for the luxury trade. The deliberate use of Eskimo motifs and identity labels creates a feeling of ethnic unity among the producers, and also provides a fresh ethnic product for the market place. Before the end of 1969 the market demand for Qiviut items had warranted the resumption of yarn supply to Mekoryuk and the introduction of knitting instruction in other Arctic villages.

The response in such villages as Shishmaref, Wainwright and St. Mary's has been such that in December of 1970, only two years after the first Qiviut workshop, a Musk Ox Producers' Co-operative was legally incorporated to supervise the production and marketing of Qiviut accessories. The Co-operative is designed to include participating Natives in the decision-making process. It is hoped that in this way they will be able to decide policies affecting their economic welfare. The implications for social change inherent in this decision to incorporate the village producers may have far-reaching consequences.

Not only in Alaska, but also in Fort Chimo, Quebec, Canada, the Eskimos are reaping economic benefits from the domestic musk ox. The

women of that village are also producing scarves and Nachaqs (a circular hood) of Qiviut. In Bardu, Norway, where the third domestic musk ox breeding station is established, a 20,000-kroner design contest for Qiviut apparel is being conducted.

It is significant that an animal once thought to be in danger of extinction now has the potential of becoming the basis of a circumpolar economy.

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APPENDIX

Appendix 1(a)

DARTMOUTH COLLEGE
Baker Library
Hanover, New Hampshire

Vilhjalmur Stefansson Collection:

25 September 1958

THE FIRST (?) PROPOSAL FOR DOMESTICATING THE MUSK OX: MEMO

Sunday, September 20, Evelyn, Carrie Thomas and I went out to Dearing Farm to pick plums. We also opened up a metal trunk on which a lot of snow and rain had fallen since our building (middle one) caved in last winter. The trunk was full of old letters and other documents, some of which had been ruined by the wet. Among the things in fairly good condition was a blue Canadian naval envelope, sealed. On its outside, in lead pencil, upper left hand corner, is the return address "V. Stefansson, Naval Service, Ottawa." Next comes the address:

"Sir Robert L. Borden
Ottawa
Canada."

Below the address, to the left, is written: "This envelope contains a sample of musk ox wool from Melville Island."

The letter follows:

North Coast Melville Island
March 15, 1917

Dear Sir Robert:

I enclose a small sample of the wool of the musk ox - an animal which, if cultivated, can make Canada, continental and insular, as productive of meat, tallow and wool as the grazing regions of Australia or the Argentine. If I get home safe from this trip I shall ask for a half-hour to tell you about the musk ox. If I do not get home, have the matter looked into. They are beyond comparison, more valuable and easier to handle than reindeer, can live in many places where reindeer cannot live, and will (I feel sure) even replace sheep and cattle on some ranges where these are now profitable, unless indeed the climate sets them too northerly a southern limit.

I most sincerely believe that musk oxen can make a square mile of the arctic tundra as valuable as sheep can a square mile of Alberta. The reindeer cannot hope to do the like, nor can the yak compete in wool or in its power to thrive near the pole.

(Signed)
Vilhjalmur Stefansson

Naval Service
Ottawa
The Hon. R. S. Borden

Appendix 1(b)

LETTERS ON MUSK OX WOOL FROM THE ACTING CHANCELLOR, UNIVERSITY OF LEEDS, TO VILHJALMUR STEFANSSON. Found among old papers and copied September 16, 1958.

From:
The Pro-Vice-Chancellor
The University, Leeds

12th December, 1923

Dear Mr. Stefansson,

The piece of cloth (9 yards) woven from Ovibos wool was offered to the King, who accepted it. I gather from the correspondence that it was intended that pieces should be offered to the Governor General of Canada and other people. At the time of sending it to London I was not aware of all the details of the correspondence on this subject or that there was any other suggestion than that of asking the King to accept the first piece. As this piece was only a trifle more than a suit length, I thought it was not desirable to divide it. I enclose a copy of the communication which was made to the press after the King's acceptance.

Being personally much attracted by the appearance of the cloth, I regret to find that there is no more wool for further experiments or for the making of pieces which might be sent to the Governor General and to yourself, and I hope you will be able to put us in the way of getting further supplies.

Yours very truly,
I. Kay Jamieson (signed)

(Communication made to the press)

In June the Canadian explorer Mr. V. Stefansson drew the attention of the Textile Department of the University of Leeds to the wool of the Ovibos (Musk Ox) which is capable of being bred in large numbers in the arctic zone of Canada and might be a considerable asset to the Dominion. The wool, of a natural brown colour, is hidden by an overgrowth of long hair which is troublesome in manufacture. The first specimen woven in the Department was brought to the notice of the King at the time of the meeting of the Imperial Conference in October, and, having expressed his interest in the experiment, His Majesty has graciously accepted the piece. Samples have been dyed successfully and further experiments are in progress to eliminate the long hairs.

The Clothworkers' Company of London, to whom the University is so greatly indebted in many ways and particularly for the building, equipment and endowment of the Textile Industries and Dyeing Departments, are showing a keen interest in these important experiments.

Appendix 1(c)

FORSTMANN WOOLEN CO.

PASSAIC, NEW JERSEY

April 3, 1935.

Miss Lydia Fohn-Hansen, Asst. Dir.
of Home Economics,
The Alaska Agricultual College,
Fairbank, Alaska.

Dear Miss Fohn-Hansen:-

The scarf you sent me was a real surprise and a happy one. It added to my collection of fibres and their products one of the most rare and interesting species. Everyone in the mill from the management down admired the wonderful touch given to the scarf thru the Musk-ox hair.

The first use I made of the scarf, was to use it as a cover on my new born son. Words realy cannot convey my sincere appreciation of this gift, but as a slight token I am enclosing $5.00 which you may use as you see fit.

Dr. Hardy, the senior biologist in Washington, D. C. told me that he intends to make a trip this summer to Alaska to visit your college. I would like very much to accompany him, but the time and the money do not allow me at present to make such a trip, just the same, I hope that in some future time to pay the college a visit.

I would appreciate it very much if you could inform me on future developments of the musk-ox wool and would be very thankful to you, if you will send me any reports that may be published.

Will you please remember me to Mr. Palmer and with best personal regards to you and wishing you further success with the experiments on musk-ox wool, I remain,

Yours very truly,

Werner Von Bergen

Werner Von Bergen,
166 Luddington Ave.,
Clifton, New Jersey.

Hadley

THE HADLEY CORPORATION

WEAVERVILLE, NORTH CAROLINA 28787

January 21, 1971

Mrs. Lillian C. Schell
Textile Specialist
University of Alaska
College, Alaska 99701

Dear Mrs. Schell:

Please pardon the tardy response to your letter of December 30 concerning the Musk Ox project. We have found a sample that we made from this yarn furnished by Forte Cashmere Corporation. The yarn is, as you state, two ply, 6¼ run, and is lot D1196 Musk Ox and our sample is marked Natural which would indicate that the color is the natural color of the fleece used in the yarn and that it has not been dyed.

There is nothing more that I can tell you that would be particularly of interest except that the sweater was made on an 18 gauge, full fashion knitting machine. This machine is manufactured by the Textile Machine Works in Reading, Pennsylvania, and is the standard machine used for men's knitted outerwear. The ribbing on the machine was made on a separate flat bed dubied rib knitter, 8 gauge. The sweater was processed as we normally process a Cashmere sweater, was given the same type of wet finishing and the usual stitching construction. We do have a sample of this sweater here should you need an additional sample for your exhibit and would be glad to forward it to you providing we could be assured that it would be returned.

Yours very truly,

THE HADLEY CORPORATION

Richard M. Taylor
Vice President

RMT/rla

Appendix 2 (a)

February 17, 1969

Dear Ann,

I have finished the third sample, on the knitting, and am sending to you.

I would like for you to send me guiniet yarn, and a pattern for making a scarf, also the needles.

Enclosed is 50¢ for the needles.

Katy told me it was cold, I hope so, hope to hear from you real soon.

Sincerely,
Elizabeth Spud

Appendix 2(b)

Mrs. Laura Kolerok
Nunivak Island
McKoryuk. Alaska
99630

April 16, 1969

Dear (Mrs) Ann Schell

Because I am interested in knitting a sample I am senting you one right now please let me know how it is. Also I am getting interested with the friends here on Nunivak Island knitting scarves.

Please sent me knitting needles and I am enclosing 50¢.

Please answer me quickly.

Sincerely
Mrs. Laura Kolerok

Mekoryuk, Alaska
April 22, 1964

Dear Ann

I'm sending you two scarves I finished. If you don't mind I'd like to knit 55 stitch scarf, But if you don't want me to I'll keep on knitting 65 stitches, which I'm knitting now.

You know Hilma Shavings I'm her mother & she showed me how to knit. and Leah is my daughter too. And I'm 55 years old.

I hand You Very much.

Sincerly Yours.

Mrs. Nan Kiokun

(1)

May 3, 1969

Dear Ann Schell

Very glad to recaved a letter and the check and yarn I just recaved it on Monday 29th so I try and finished it and I send it here I'm always having fun to make a scarf. hoping to get new spinning wheel so I can spin better not like my old timer spinning wheel. maybe I can spin finer than before now. I'll be glad to hear from you again. and be glad to hear yours babys name good luck to you and baby. my mom makes me worry because all over suten she get ~~weak~~ Week she can't even stand or can't get up herself I got to help her she is to old now I think. hope she get well again even she is old. well I don't have much to say

over

(2)

well hope you have good luck on the baby. and thank you very much for your help its the only my help by knitting because I don't have help from welfare. if I realy need it I would ask them but when I still knite it help me little.

well the spring is comming again but it is cold right now north wind after the ice is almost gone but it comes back. well I don't have much to say now and see you on your next letter.

Yours friend

Katie Toothkaylok

Appendix 2(e)

June 24, 1969

Dear Ann,

Enclosed is the scarf I knitted. Hope it is knitted right. Maybe by the time you send me another yarn I'll be gone to fish camp, but please send me another yarn, if I recieve it before I get to fish camp I might want to do something besides fishing, that is in my spare time.

I'll be happy to knit another scarf. and thank you.

Friendly Regards
Mrs. Edith Bloat

Appendix 2(f)

August 29, 196

Dear Ann Sahell,

Hi! again. I and my family are doing fine, and I hope you and your baby are doing fine too.

I got back from fish camp and hope you had a good summer there.

I finish this scarf and it took me quite a while to finish it but I had fun knitting it.

You also requested for the old pattern (single Harp So I'll sending it back, but its kind of dirty and wrinkled

Hope you send me some more quiet, so I could knit some more scarves.

Sincerely

Enclosed: scarf MRS. Edith Flory
single Harpoon pattern

Appendix 2(g)

9/24/69

Dear Ann,

I have let one of my friends use some of the equivint you sent (8.7 Grams) because she needed some, as hers was not quite enough, I have used some of hers earlier, so I let her use mine in exchange.

Could you please send me more equivint to finish mine with, maybe I'll need to finish about four repeats on the thirpoon plus the end.

Thanks much

Sincerely

Elizabeth Speed

Appendix 2(h)

Laura Kolenik
McKeesport
Oct. 24, 1969

24 Oct 69

Dear Ann Schell,

I finally finished my second triple harpoon. I am returning my left over yarn sorry it's so few because my friends here whose knitting quivit 2 ply borrowed it so much I hope you don't mind.

I hope to hear from you again of the knitting in future.

I'm still interested in knitting 2 ply musk-ox quivit.

Thanks Again
Mrs. Laura Kolenik

Appendix 3

Name:	Pattern	Date Sent	Gr./ply	Date Rec'd	Note	Gr. Wt.	Dimensions:
Amos, Cecilia	T.H.	2 July	27.7/2	15 Sept.	*	20.3	36 cm x 119 cm (14" x 47")
	T.H.	24 Sept.	21.9/2	14 Oct.		20.4	33 cm x 132 cm (13" x 52")
Amos, Nona	H.	19 Mar.	35/4	3 April		18.9	33 cm x 150 cm (13" x 59")
	H.	4 April	20.7/2	25 April	*	16.5	≠
	H.			23 May		16.3	30 cm x 122 cm (12" x 48")
	H.	26 May	17.5/2	6 June		17.4	36 cm x 122 cm (14" x 48")
	H.	10 June	18.2/2	20 June		17.2	33 cm x 122 cm (13" x 48")
	H.	23 June	17.7/2	1 July		17.7	30 cm x 117 cm (12" x 46")
	T.H.	3 July	20/2	2 Sept.	*	19.1	36 cm x 122 cm (14" x 48")
Andrew, Bertha	H.	2 April	17.8/2	25 April		16.8	≠
	H.	13 June	17.6/2	20 June		17.4	≠
	H.	1 July	20/2	8 Aug.		16.4	30 cm x 114 cm (12" x 45")
	T.H.	12 Aug.	24.9/2	9 Sept.	*	19.9	33 cm x 142 cm (13" x 56")
Baker, Emily	H.	28 Jan.	40/4	18 Feb.		32	30 cm x 137 cm (12" x 54")
	H.	19 Feb.	32.5/2	7 April		19.3	41 cm x 137 cm (16" x 54")
	H.			7 April		19.5	36 cm x 137 cm (14" x 54")
	H.	9 April	18.8/2	29 April	*	18	33 cm x 145 cm (13" x 57")
	H.	6 June	20.9/2	16 June		20.7	33 cm x 142 cm (13" x 56")
	H.	18 June	20/2	11 July		19.6	38 cm x 125 cm (15" x 49")
David, Eula	H.	19 May	18/2	1 July		18.7	28 cm x 122 cm (11" x 48")
	H.	3 July	19.8/2	21 Oct.		18.5	38 cm x 127 cm (15" x 50")
	T.H.			21 Oct.		20.8	33 cm x 150 cm (13" x 59")

* Returned to knitter to be re-bound off more loosely.
≠ Data not recorded.

Name:	Pattern	Date Sent	Gr./ply	Date Rec'd	Note	Gr. Wt.	Dimensions:
David, Rosie J.	T.H.	6 Aug.	20/2	23 Sept.		20.1	41 cm x 137 cm (16" x 54")
Davis, Irene	H.	1 April	16/2	25 April		17.1	33 cm x 119 cm (13" x 47")
	H.	26 May	17.4/2	6 June	*	20.0	30 cm x 137 cm (12" x 54")
	H.	10 June	21.5/2	20 June		19.4	38 cm x 147 cm (15" x 58")
	H.	23 June	21.2/2	1 July		20.5	33 cm x 127 cm (13" x 50")
	T.H.	12 Sept.	24.4/2	8 Oct.		23.1	43 cm x 145 cm (17" x 57")
Float, Edith	H.	14 Mar.	37.5/4	28 Mar.		42.7	41 cm x 122 cm (16" x 48")
	H.	1 April	19/2	16 April		20.8	41 cm x 139 cm (16" x 55")
	H.	18 April	19.9/2	5 May		17.5	30 cm x 119 cm (12" x 47")
	H.	19 May	20/2	2 June		17.3	36 cm x 147 cm (14" x 58")
	H.	6 June	18.5/2	13 June		19.7	30 cm x 137 cm (12" x 54")
	H.	18 June	21.2/2	1 July		18.7	30 cm x 122 cm (12" x 48")
	T.H.	16 July	19.6/2	2 Sept.		20.3	41 cm x 119 cm (16" x 47")
	T.H.	8 Sept.	25.2/2	3 Nov.		19.5	38 cm x 122 cm (15" x 48")
Hendrickson, Mollie	H.	7 Jan.	25/4	17 Mar.		34.2	30 cm x 122 cm (12" x 48")
	H.	17 Jan.	22.7/4	16 April		15.6	30 cm x 107 cm (12" x 42")
	H.	18 April	18.4/2	12 May	*	15.8	33 cm x 114 cm (13" x 45")
	H.	23 May	15.4/2	4 June		16.0	30 cm x 112 cm (12" x 44")
	H.	6 June	23.1/2	16 June	*	18.7	33 cm x 81 cm (13" x 32")
	H.			23 June		17.6	30 cm x 122 cm (12" x 48")
	H.	23 June	18.7/2	1 July		16.2	30 cm x 112 cm (12" x 44")
	H.			1 July		17.8	33 cm x 112 cm (13" x 32")
Ivanoff, Gertrude	H.	19 May	19.6/2	2 June		15.4	30 cm x 114 cm (12" x 45")
	H.	6 June	16.2/2	13 June		17.7	33 cm x 117 cm (13" x 46")
	H.	18 June	18.3/2	1 July		17.0	28 cm x 105 cm (11" x 41")
	H.	3 July	20.5/2	22 July		17.2	30 cm x 107 cm (12" x 42")
	T.H.	23 July	20.7/2	25 Aug.		19.0	33 cm x 105 cm (13" x 41")
	T.H.	26 Aug.	25.2/2	2 Sept.		18.4	38 cm x 119 cm (15" x 47")
	T.H.	8 Sept.	18.5/2	15 Sept.		18.7	33 cm x 117 cm (13" x 46")
	T.H.	23 Sept.	22.3/2	29 Sept.		19.3	36 cm x 119 cm (14" x 47")
	T.H.			17 Oct.		19.7	36 cm x 122 cm (14" x 48")

Name:	Pattern	Date Sent	Gr./ply	Date Rec'd	Note	Gr. Wt.	Dimensions:
John, Dora	H.	1 April	18.2/2	25 April	*	19.2	33 cm x 114 cm (13" x 45")
	H.	28 May	18.6/2	10 July	*	16.3	28 cm x 91 cm (11" x 36")
Joshua, Nellie	H.	19 May	19.9/2	4 June		18.9	36 cm x 132 cm (14" x 52")
	H.	6 June	20.0/2	16 June		17.7	36 cm x 125 cm (14" x 49")
	H.	18 June	18.0/2	1 July		18.8	30 cm x 105 cm (12" x 41")
	T.H.	3 July	21.0/2	28 July		20.4	41 cm x 119 cm (16" x 47")
	T.H.	30 July	23.7/2	12 Aug.		21.1	43 cm x 127 cm (17" x 50")
	T.H.	13 Aug.	20.6/2	21 Aug.		20.5	41 cm x 142 cm (16" x 56")
	T.H.	21 Aug.	23.3/2	28 Aug.		21.5	38 cm x 114 cm (15" x 45")
	T.H.	2 Sept.	30.7/2	17 Sept.		19.8	33 cm x 117 cm (13" x 46")
	T.H.	---	---	17 Sept.		18.7	30 cm x 114 cm (12" x 45")
	T.H.	23 Sept.	25.1/2	7 Oct.		17.7	33 cm x 105 cm (13" x 41")
	T.H.	24 Sept.	23.0/2	21 Oct.		18.2	30 cm x 107 cm (12" x 42")
King, Margie	H.	24 Dec.	20.0/4				
	H.	14 Jan.	25.0/0	13 Feb.		35.2	30 cm x 142 cm (12" x 56")
	H.	20 Feb.	30.0/4	28 Mar.		34.8	33 cm x 127 cm (13" x 50")
	H.	1 April	17.8/2	25 April		18.1	33 cm x 81 cm (13" x 32")
	H.	14 May	20.0/2	23 June		17.7	36 cm x 122 cm (14" x 48")
	H.	23 June	17.8/2	4 Aug.		17.7	33 cm x 119 cm (13" x 47")
King, Rose	H.	19 Mar.	35.0/4	16 April		17.2	36 cm x 107 cm (14" x 42")
	H.	18 April	20.9/2	29 April		17.1	30 cm x 109 cm (12" x 43")
	H.	14 May	20.1/2	26 May		17.3	30 cm x 117 cm (12" x 46")
	H.	28 May	19.6/2	12 June		20.0	33 cm x 132 cm (13" x 52")
	H.	13 June	23.7/2	2 July		19.3	33 cm x 81 cm (13" x 32")
	T.H.	16 July	27.4/2	26 Sept.		23.7	51 cm x 105 cm (20" x 41")
Kiokun, Nan	H.	19 Mar.	35.0/4	7 April		17.5	36 cm x 119 cm (14" x 47")
	H.	9 April	20.6/2	25 April		16.7	33 cm x 114 cm (13" x 45")
	H.			25 April	*	17.1	33 cm x 114 cm (13" x 45")
	H.	26 May	19.2/2	6 June		14.6	33 cm x 112 cm (13" x 44")
	H.	10 June	22.5/2	20 June		14.9	28 cm x 112 cm (11" x 44")

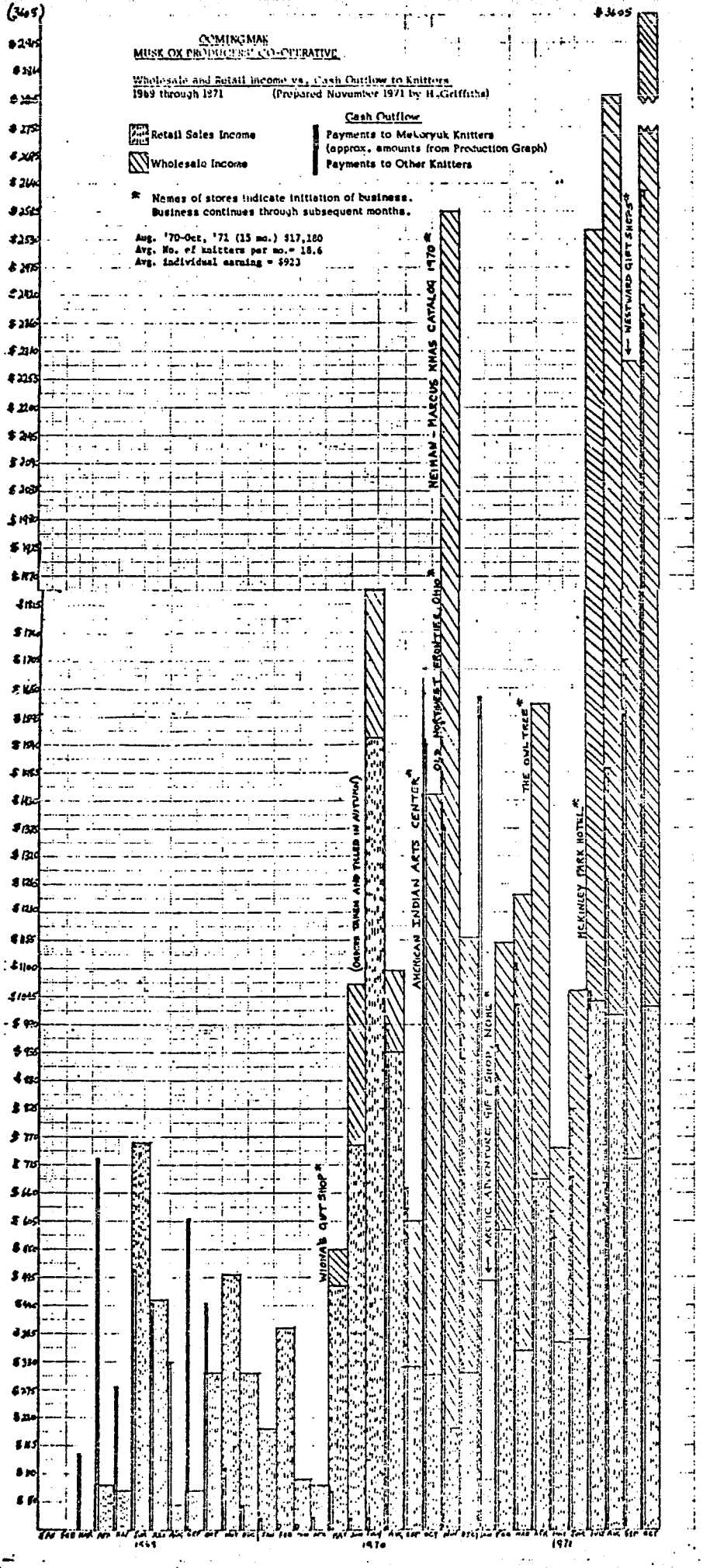
Name:	Pattern	Date Sent	Gr./ply	Date Rec'd	Note	Gr. Wt.	Dimensions:
Kiokun, Nan	H.	23 June	16.3/2	3 July		14.3	28 cm x 112 cm (11" x 44")
	H.			3 July		15.9	33 cm x 112 cm (13" x 44")
	H.	16 July	19.5/2	2 Sept.		14.0	28 cm x 99 cm (11" x 39")
	T.H.			2 Sept.		18.8	33 cm x 119 cm (13" x 47")
	T.H.	8 Sept.	18.8/2	17 Oct.		20.9	36 cm x 129 cm (14" x 51")
Kolerok, Laura	H.	19 May	24.4/2	12 June		18.0	33 cm x 114 cm (13" x 45")
	H.	13 June	21.0/2	7 July		18.7	33 cm x 112 cm (13" x 44")
	T.H.	23 July	25.8/2	17 Sept.	*	22.7	38 cm x 135 cm (15" x 53")
	T.H.	24 Sept.	23.0/2	24 Oct.		23.2	38 cm x 152 cm (15" x 60")
Kopanuk, Anna	H.	27 Jan.	41.5/4	28 Feb.		31.7	30 cm x 122 cm (12" x 48")
	H.	"	40.0/4	13 Mar.		30.7	36 cm x 102 cm (14" x 40")
	H.	3 Mar.	30.0/2	28 Mar.		14.9	30 cm x 114 cm (12" x 45")
	H.	1 April	15.3/2	5 May	*	21.1	33 cm x 150 cm (13" x 59")
Mathlaw, Alice	T.H.	7 July	21.0/2	2 Sept.		20.9	36 cm x 122 cm (14" x 48")
	T.H.	8 Sept.	23.5/2	2 Oct.		20.1	36 cm x 122 cm (14" x 48")
Mathlaw, Edna R.	H.	3 Mar.	35.0/4	11 Mar.		29.7	30 cm x 119 cm (12" x 47")
	H.	12 Mar.	22.0/4	26 Mar.		"	30 cm x 89 cm (12" x 35")
	H.	14 Mar.	15.2/2	28 Mar.		17.0	36 cm x 119 cm (14" x 47")
	H.	27 Mar.	17.9/2	2 April		18.2	33 cm x 125 cm (13" x 49")
	H.	1 April	5.5/2	3 April		17.3	41 cm x 119 cm (16" x 47")
		2 April	7.3/2	----		--	----------
	H.	18 April	17.2/2	29 April		17.4	30 cm x 117 cm (12" x 46")
	H.	14 May	21.0/2	2 June		18.9	30 cm x 127 cm (12" x 50")
	H.	6 June	18.1/2	13 June	*	18.2	28 cm x 105 cm (11" x 41")
	T.H.	3 July	20.0/2	25 Aug.		19.5	33 cm x 105 cm (13" x 41")
	T.H.	26 Aug.	20.0/2	15 Sept.	⊕	19.9	33 cm x 105 cm (13" x 41")
Mathlaw, Muriel	T.H.	8 July	26.7/2	18 Sept.		20.6	30 cm x 135 cm (12" x 53")
	T.H.	23 Sept.	24.0/2	31 Oct.		18.9	36 cm x 132 cm (14" x 52")

⊕ Returned for stitch correction.

Name:	Pattern	Date Sent	Gr./ply	Date Rec'd	Note	Gr. Wt.	Dimensions:
Olrun, Leah	H.	11 Feb.	40.0/4	21 Mar.		32.8	28 cm x 122 cm (11" x 48")
	H.	25 Mar.	26.1/2	3 April		14.2	30 cm x 114 cm (12" x 45")
	H.	4 April	22.7/2	21 April		14.5	30 cm x 119 cm (12" x 47")
	H.			21 April	*	14.5	30 cm x 112 cm (12" x 44")
	H.	23 April	5.5/2	5 May		15.2	30 cm x 119 cm (12" x 47")
	H.	28 May	17.4/2	12 June		14.7	30 cm x 112 cm (12" x 44")
	H.	13 June	17.0/2	19 June		15.0	30 cm x 109 cm (12" x 43")
	H.	27 June	15.2/2	11 July		15.1	30 cm x 99 cm (12" x 39")
	T.H.	16 July	29.7/2	17 Oct.		19.5	38 cm x 119 cm (15" x 47")
Shavings, Alma Rose	H.	7 Mar.	26.3/4	25 Mar.		30.8	30 cm x 122 cm (12" x 48")
	H.	26 Mar.	18.5/2	21 April		15.6	≠
	H.	23 April	16.0/2	22 May		16.4	33 cm x 102 cm (13" x 40")
	H.	23 May	20.0/2	20 June	*	17.0	28 cm x 102 cm (11" x 40")
	T.H.	3 July	26.8/2	22 Sept.		17.9	25 cm x 117 cm (10" x 46")
Shavings, Amy	H.	1 April	16.6/2	5 May	*	17.4	33 cm x 117 cm (13" x 46")
	H.	23 May	21.8/2	1 July		18.7	33 cm x 114 cm (13" x 45")
Shavings, Ester	H.	19 Feb.	40.0/4	13 Mar.		33.5	33 cm x 122 cm (13" x 48")
	H.	14 Mar.	15.0/2	25 Mar.		14.0	28 cm x 119 cm (10" x 47")
	H.	26 Mar.	22.3/2	11 April		15.7	30 cm x 122 cm (12" x 48")
	H.	14 April	16.2/2	18 April		15.8	30 cm x 105 cm (12" x 41")
	H.	22 April	16.0/2	29 April		15.8	30 cm x 114 cm (12" x 45")
	H.	-----	---	12 May		16.5	36 cm x 114 cm (14" x 45")
	H.	3 June	16.3/2	7 July	*	17.8	28 cm x 122 cm (11" x 48")
	T.H.	15 July	20.7/2	17 Oct.		19.5	33 cm x 125 cm (13" x 49")
Shavings, Hilma	H.	31 Dec.	27.9/4	13 Jan.		21.5	30 cm x 91 cm (12" x 36")
	H.	17 Jan.	44.8/4	5 Feb.		29.0	30 cm x 102 cm (12" x 40")
	H.	7 Feb.	27.6/2	24 Feb.		28.8	25 cm x 122 cm (10" x 48")
	D.H.	-----	---	24 Feb.		13.2	25 cm x 112 cm (10" x 44")
	D.H.	26 Feb.	29.5/2	17 Mar.		13.3	38 cm x 89 cm (15" x 34")
	D.H.	19 Mar.	20.0/2	27 Mar.		13.8	33 cm x 94 cm (13" x 37")
	H.	19 Mar.	---	27 Mar.		11.4	25 cm x 109 cm (10" x 43")

Name:	Pattern	Date Sent	Gr./ply	Date Rec'd	Note	Gr. Wt.	Dimensions:
Shavings, Hilma	D.H.	28 Mar.	19.5/2	1 Apr.		20.4	43 cm x 109 cm (17" x 43")
	H.	2 Apr.	16.6/2	5 May		17.0	30 cm x 125 cm (12" x 49")
	H.	2 Apr.	---	5 May		17.3	36 cm x 109 cm (14" x 43")
	H.	19 May	18.5/2	13 June		17.3	28 cm x 109 cm (11" x 43")
	H.	17 Jun.	21.0/2	1 July		15.4	28 cm x 109 cm (11" x 43")
	H.	----	---	1 July		17.6	33 cm x 109 cm (13" x 43")
	T.H.	29 July	23.8/2	12 Aug.		19.4	38 cm x 119 cm (15" x 47")
	T.H.	13 Aug.	21.5/2	2 Sept.		20.0	41 cm x 125 cm (16" x 49")
	T.H.	8 Sept.	22.2/2	30 Sept.		19.9	36 cm x 119 cm (14" x 47")
Shavings, Susie	H.	26 May	17.7	12 June		16.5	33 cm x 112 cm (13" x 44")
	H.	13 June	18.0/2	1 July		17.0	30 cm x 114 cm (12" x 45")
	T.H.	3 July	19.8/2	4 Sept.		21.4	33 cm x 117 cm (13" x 46")
	T.H.	8 Sept.	22.5/2	17 Oct.		20.7	36 cm x 122 cm (14" x 48")
Spud, Elizabeth	H.	26 Feb.	45.9/4	17 Mar.		29.7	
	H.	19 Mar.	15.0/2	14 Apr.		17.2	30 cm x 119 cm (12" x 47")
	H.	17 Apr.	19.5/2	25 Apr.	*	17.1	30 cm x 119 cm (12" x 47")
	H.	---	---	9 May		17.3	30 cm x 119 cm (12" x 47")
	H.	23 May	20.0/2	4 June		18.5	30 cm x 119 cm (12" x 47")
	H.	6 June	21.4/2	24 July		18.4	36 cm x 119 cm (14" x 47")
	T.H.	28 July	23.1/2	2 Sept.		18.9	36 cm x 112 cm (14" x 44")
	T.H.	8 Sept.	18.7/2	8 Sept.		18.9	28 cm x 135 cm (11" x 53")
	T.H.	23 Sept.	20.0/2	6 Oct.		20.0	33 cm x 122 cm (13" x 48")
	T.H.	13 Oct.	17.6/2	24 Oct.		19.2	36 cm x 127 cm (14" x 50")
Tootkaylok, Kasie	H.	7 Jan.	70.0/4	16 Jan.		27.0/4	30 cm x 102 cm (12" x 40")
	H.			13 Mar.		30.7/4	30 cm x 122 cm (12" x 48")
	H.	19 Mar.	20.0/2	15 Apr.		18.5	36 cm x 119 cm (14" x 47")
	H.	18 Apr.	19.9/2	5 May		17.9	30 cm x 117 cm (12" x 46")
	H.	26 May	20.6/2	11 June		18	33 cm x 119 cm (13" x 47")
	H.	13 June	18.4/2	20 June		18	33 cm x 132 cm (13" x 42")
	H.	23 June	19.1/2	30 June		19	38 cm x 155 cm (16" x 61")
	T.H.	3 July	30/2	11 July		19.7	36 cm x 119 cm (14" x 47")

Name:	Pattern	Date Sent	Gr./ply	Date Rec'd	Note	Gr. Wt.	Dimensions:
Tootkaylok, Katie	T.H.	16 July	36.5/2	5 Aug.		25.2	38 cm x 152 cm (15" x 60")
	T.H.	31 July	49.2/2	5 Aug.		25.3	38 cm x 152 cm (15" x 60")
	T.H.	5 Aug.	24.5/2	28 Aug.		23.3	41 cm x 135 cm (16" x 53")
	T.H.	21 Aug.	26.4/2	5 Sept.		20.3	43 cm x 119 cm (17" x 47")
	T.H.	2 Sept.	20.2/2	17 Sept.		20.6	30 cm x 125 cm (12" x 49")
	T.H.	23 Sept.	21.6/2	17 Oct.		20.3	36 cm x 122 cm (14" x 48")
Weston, Lydia	H.	Jan.	27.0/4	20 Jan.		26.5	28 cm x 102 cm (11" x 40")
	H.	22 Jan.	37.4/4	11 Feb.		37.0	30 cm x 150 cm (12" x 49")
	H.	13 Feb.	39.0/4	11 Mar.		30.5	30 cm x 119 cm (12" x 47")
	H.	12 Mar.	15.0/2	28 Mar.		13.7	30 cm x 109 cm (12" x 43")
	H.	1 Apr.	16.1/2	21 Apr.		17.4	30 cm x 139 cm (12" x 55")
	H.	23 Apr.	17.6/2	11 June		19.1	
	H.	13 June	20.3/2	11 July	●	22.1	30 cm x 119 cm (12" x 47")
	T.H.	28 July	19.7/2	3 Nov.	●	19.6	
	T.H.	14 Nov.	7.0/2				
	T.H.	12 July	2.6/2				
Whitman, Lucy	T.H.	7 July	24.3/2	28 Aug.		19.9	36 cm x 129 cm (14" x 51")
	T.H.	2 Sept.	23.2/2	23 Sept.	*	21.0	
	T.H.	23 Sept.	23.9/2	8 Oct.		22.4	36 cm x 147 cm (14" x 48")



Appendix 4 Wholesale and retail income vs. cash outflow to knitters - 1969 through 1971